



WASHINGTON STATE DEPARTMENT OF
Natural Resources

SUBDIVISION OF SECTIONS

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2006 Land Survey Refresher Course
Land Surveyors' Association of Washington
February 9, 2006

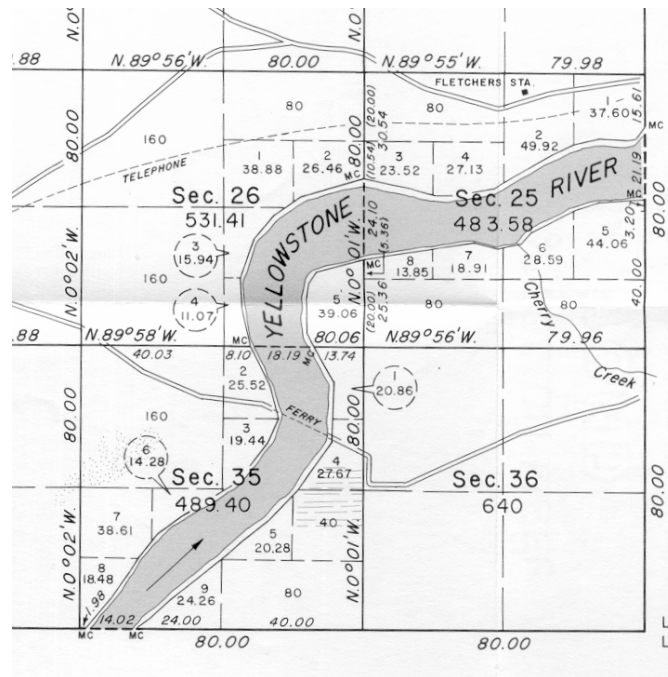
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Outline

1. Introduction to Section Subdivision
2. Subdivision of Regular Sections
3. Subdivision of Closing Sections
4. Subdivision of Fractional Sections
5. Surveys of Parts of Sections and Completion Surveys
6. Subdivision by Protraction and Subdivision by Survey
7. Theoretical Section Subdivision and Found Survey Monuments

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From the Sample Plat in the BLM Manual



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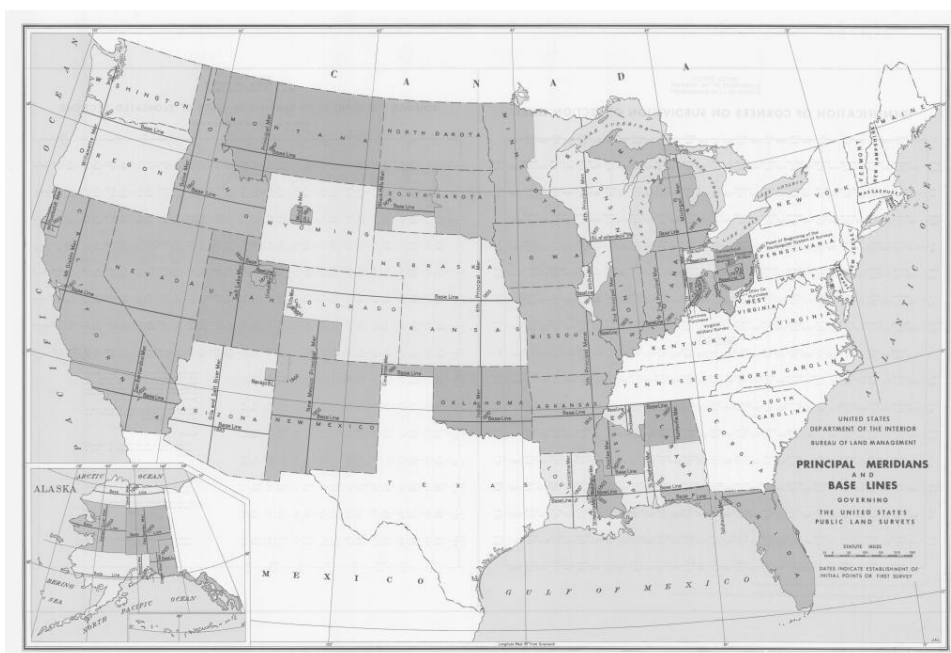
Rules for subdividing a section into 1/16 sections and government lots.

1. *The center 1/4 corner is at the intersection of the lines connecting opposite 1/4 corners.*
2. *When no opposite 1/4 corner can be fixed, survey on a mean or parallel bearing.*
3. *A 1/16 corner is:*
 - a) *At the midpoint between 1/4 corners when there are no government lots involved.*
 - b) *At a proportioned distance between 1/4 corners when there are government lots involved.*
 - c) *At a proportioned distance when the nearest controlling corner is not a 1/4 corner, for example a meander corner or a line tree.*
4. *The center of a quarter section is at the intersection of lines connecting opposite 1/16 corners.*
5. *When no opposite 1/16 corner can be fixed, survey on a mean or parallel bearing.*

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Part 1: Introduction to Section Subdivision



The Act of February 11, 1805, established the Public Land Survey System as we know it.

The act is codified in Chapter 18 of Title 43 of the United States Code and is still the law of the land. The Act settled several basic principles of the subdivision of townships and sections.

- (1) Corners and lines established by United States survey are to be held as correct and proper corners and lines.*
- (2) After an original survey, subdivisions are to be made by connecting opposite corners with straight lines.*
- (3) Where no such opposite corners exist, boundaries shall be made by running from established corners in a cardinal direction.*
- (4) The corners of half and quarter sections, not marked by the original survey, shall be placed as nearly as possible equidistant from the two corners which stand on the same line.*
- (5) The acreage returned by United States survey shall be considered as exact.*

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The words of the Act were soon seen to require interpretation.

- On April 3, 1805, Surveyor General Jared Mansfield wrote to Secretary of the Treasury (his boss), Albert Gallatin, and discussed the Act of February 11, 1805. His primary concern was the subdivision of fractional sections.*
- The second clause of Sec. 2 of the act said that fractional sections were to be subdivided by running due north and south or east and west from the quarter-section corners to an intersection with the boundary, which made the section fractional.*
- He (Surveyor General Jared Mansfield) advocated that this procedure wasn't proper unless the section boundaries were actually on a true cardinal bearing and that the subdivisional lines would have to be run parallel to the established section boundaries or mean courses would have to be adopted. This method of subdivision was adopted by Mansfield as following the intent of the law and is the present-day practice.*

The Act of April 5, 1832 provided for sales in areas as small as the quarter-quarter section and specified that the principles of the Act of February 11, 1805 apply to section subdivision.

“And in every case of a division of a half-quarter section, the line for the division thereof shall run east and west, and the corners and contents of the quarter-quarter sections, which may thereafter be sold, shall be ascertained as nearly as may be, in the manner, and on the principles, directed and prescribed by the second section of an act, entitled “An act concerning the mode of surveying the public lands of the United States,” passed on the eleventh day of February, eighteen hundred and five.”

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County and Local Surveyors

The Act of July 9, 1870, codified in Title 43, Chapter 18, Paragraph 766 of United States Code, for the first time officially allowed **county and local surveyors** to subdivide surveyed public land. In practice, they had been subdividing sections since much earlier.

“and all subdividing of surveyed lands into lots less than one hundred and sixty acres may be done by county and local surveyors at the expense of claimants”

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The Function of the Local Surveyor

The 1973 Manual summarizes the function of the local surveyor and gives some guidelines for performance.

3-76. The local land surveyor is employed as an expert to identify lands which have passed into private ownership In this capacity the local surveyor is performing a function contemplated by law. He cannot properly serve his client or the public unless he is familiar with the legal requirements concerning subdivision of sections.

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Federal Accuracy requirements for a legal survey.

The United States Code, Title 43, Chapter 18

§ 752. *Boundaries and contents of public lands; how ascertained*

*... and the corners of half and quarter sections, not marked on the surveys, shall be placed **as nearly as possible** equidistant from two corners which stand on the same line.*

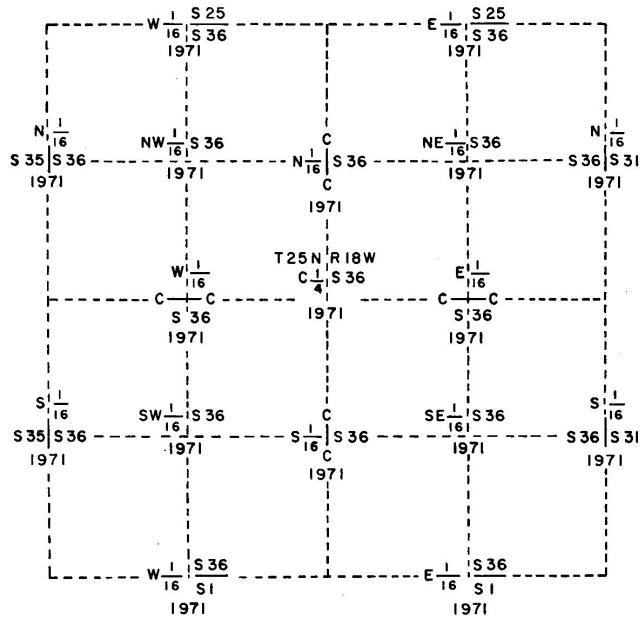
§ 753. *Lines of division of half quarter sections; how run*

*... on the principles directed and prescribed by section 752 of this title ... shall in like manner **as nearly as practicable** be subdivided into half and quarter-sections ... shall in like manner, **as nearly as practicable**, be subdivided into quarter quarter-sections*

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Corner Designations

MONUMENTATION



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Part 2: Subdivision of Regular Sections

TOWNSHIP LINE					
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36
RANGE LINE					

FIGURE 2.—A regular township.

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A regular section is composed exclusively of aliquot parts.

From the Glossaries of BLM Surveying and Mapping Terms

ALiquot - Contained an exact number of times in another; a part of a measurement that divides the measurement without a remainder. See ALIQUOT PARTS.

ALiquot PARTS - Legal subdivisions, except fractional lots, or further subdivision of any smaller legal subdivision, except fractional lots, by **division into halves or fourths** ad infinitum

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Steps for subdividing a regular section into aliquot parts per the BLM manual.

(1) Subdivision of Sections Into Quarter Sections

3-87. To subdivide a section into quarter sections, run straight lines from the established quarter-section corners to the opposite quarter-section corners. The point of intersection of the lines thus run will be the corner common to the several quarter sections, or the legal center of the section.

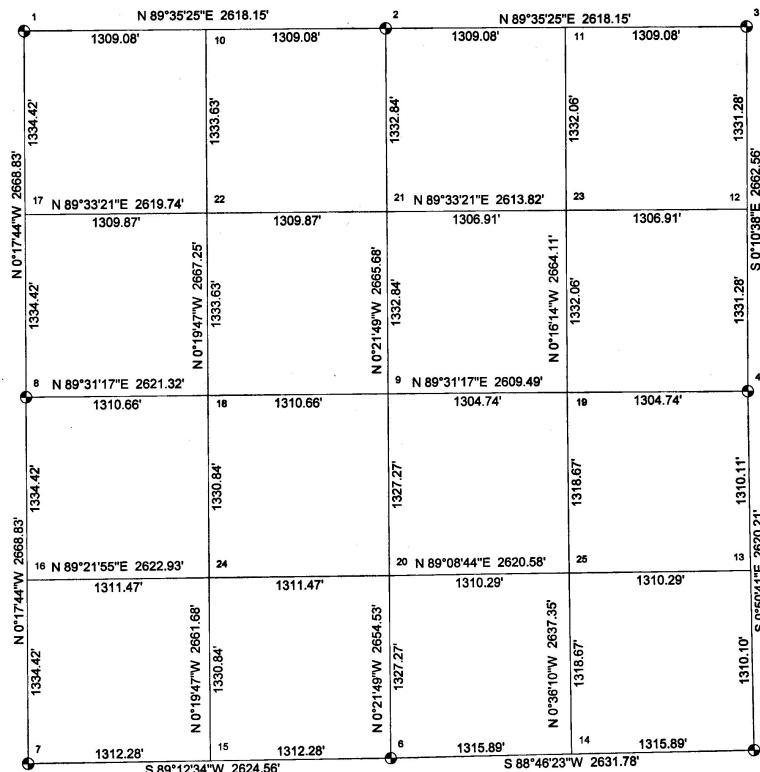
(2) Subdivision of Quarter Sections

3-89. Preliminary to the subdivision of quarter sections, the quarter-quarter or sixteenth-section corners will be established at points midway between the section and quarter-section corners, and between the quarter-section corners and the center of the section, except on the last half mile of the lines closing on township boundaries, where they should be placed at 20 chains, proportionate measurement counting from the regular quarter-section corner.

The quarter-quarter or sixteenth-section corners having been established as directed above, the center lines of the quarter section will be run straight between opposite corresponding quarter-quarter or sixteenth-section corners on the quarter-section boundaries. The intersection of the lines thus run will determine the legal center of a quarter section.

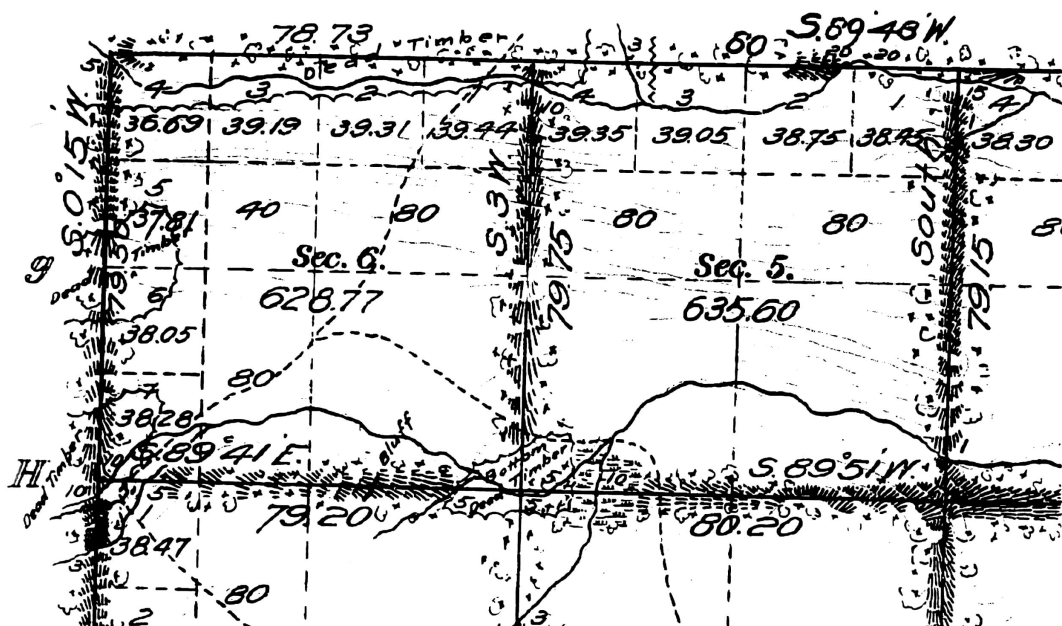
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Example
subdivision
of a regular
section
based on
federal law.





Part 3: Subdivision of Closing Sections



AREAS AND PARENTHETICAL DISTANCES

From BLM Glossary:

"Distances noted on the plats in parentheses are those regular and fractional portions of lines constituting the boundaries of the quarter-quarter sections and fractional subdivisions bounded thereby. Parentheses are used where the record is not supplied by the field notes, indicating that the distance was not measured on the ground. The figures show what was used in the calculation of areas. The same lengths are to be adopted proportionately whenever there is a need for an establishment of sixteenth-section corners on the section boundaries, and for control points for the subdivision of sections."

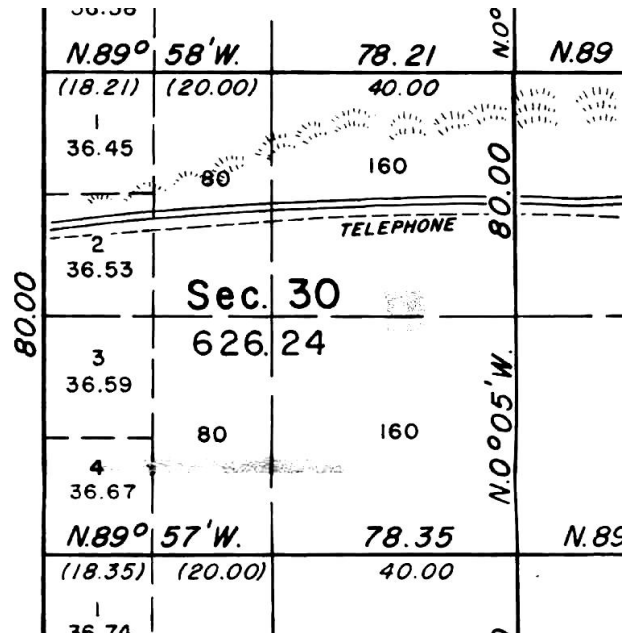
21

AREAS AND PARENTHETICAL DISTANCES

Most older GLO plats do not show the parenthetical distances, showing only the areas of Government Lots. Parenthetical distances are needed in order to subdivide closing sections. It is impossible to compute the 1/16 corners in a closing section without knowing the parenthetical distances to the closing line. One must calculate the parenthetical distances and then see if the area calculations are consistent with the parentheticals. Sometimes there are errors in the areas shown. Usually the areas shown will help us in calculating the parentheticals.

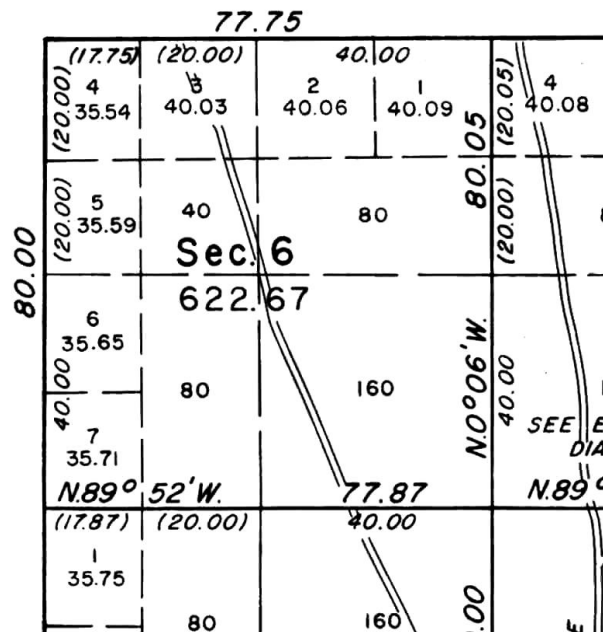
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Some closing section examples, from the BLM sample plat, showing parenthetical distances.



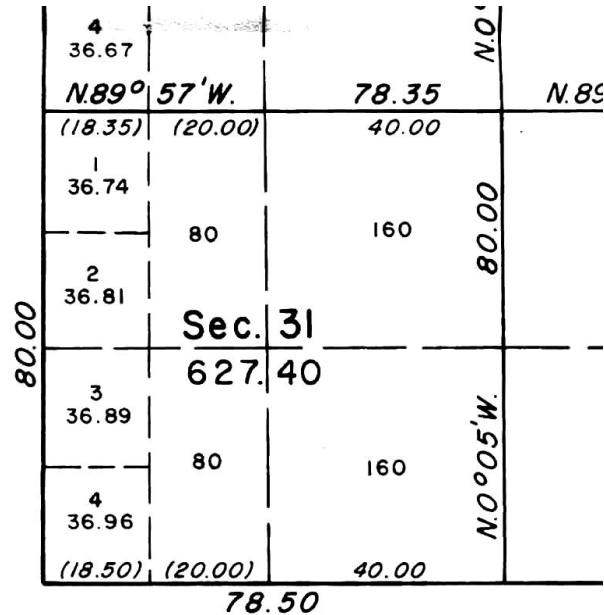
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From the BLM Sample Plat



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From the BLM Sample Plat



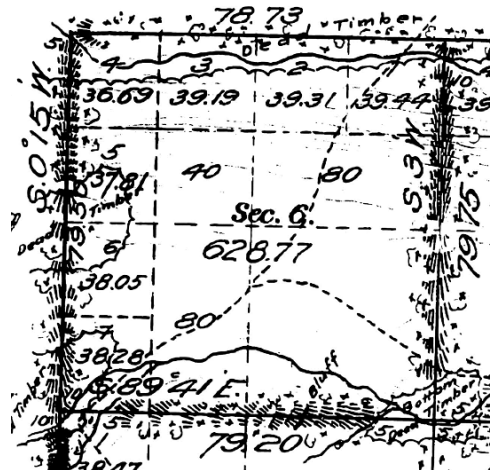
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Example of the importance of areas and parenthetical distances?

In order to subdivide section 6 one needs to be able to proportion the CN1/16, the N1/16 on the east and west lines, the CW1/16, and the W1/16 corners on the north and south lines.

The parenthetical distances along those lines are required for the proportioning.

It is necessary consider the areas when calculating the parenthetical distances along the section centerlines.



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An Acre is 10 Square Chains

To compute the area of a Government Lot that is 20 chains wide or high, add the two side distances, in chains, together.

The reason for this is that every chain in height or width of the lot adds 2 acres to the size of the lot. 1 chain x 20 chains = 20 square chains = 2 acres. So, twice the average height of the lot in chains is the acreage of the lot. The sum of the two side distances is twice the average height of the lot.

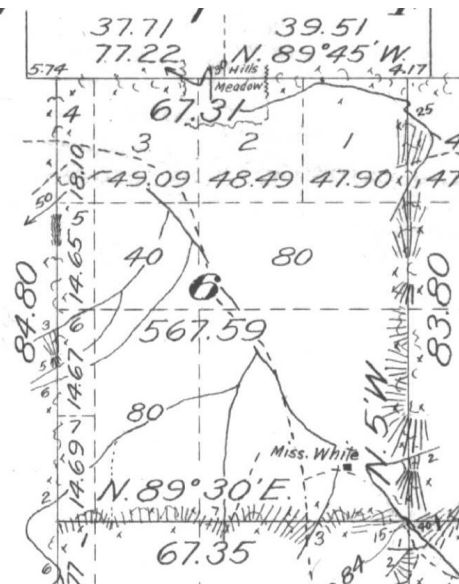
The distance of the line separating two lots, each 20 chains wide, is the sum of areas divided by four.

This is because the area of a figure 40 chains wide is four times the average height of the area. The length of line dividing the area into two 20 chain wide lots is the average height of the two lots.

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Use Acreages to Compute Parenthetical Distances

- The distance between lots 2 and 3 is $(49.09 + 48.49) / 4 = 24.395$
- The distance between lots 1 and 2 is $47.90 - 23.80 = 24.10$
- The distance between lots 2 and 3 is $48.49 - 24.10 = 24.39$
- Don't use easy solutions like meaning the parenthetical distances on opposite section lines. The distance between lots 2 and 3 is not $(23.80 + 24.80) / 2 = 24.30$
- The distance between lots 5 and 6 is $(14.67 + 14.65) / 4 = 7.33$
- The distance between lots 6 and 7 is $14.69 - 7.35 = 7.34$
- The distance between lots 5 and 6 is $14.67 - 7.34 = 7.33$
- In this case the mean of opposite parenthetical distances gives the right answer. The distance between lots 5 and 6 is $(7.35 + 7.31) / 2 = 7.33$



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Computation of the Areas of Government Lots in the 1973 BLM Manual

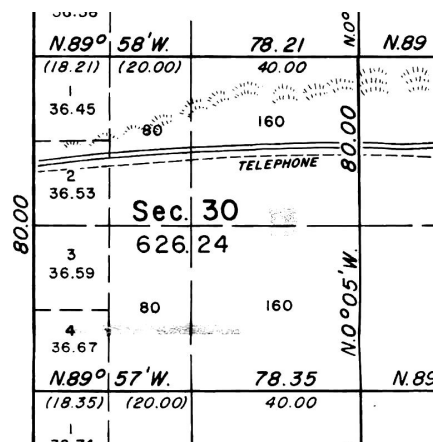
9-24. *The deficiency in area which results from the convergency of meridians is placed normally in the fractional lots adjoining the west boundary of the township. Sections 7, 18, 19, 30, and 31 each usually contains lots 1 to 4, inclusive, whose meridional dimensions are all an even 20 chains; the dimensions of the latitudinal boundaries of these lots are computed proportionately from the fractional measurements ascertained on the section lines. The area, in acres of each lot, is then found simply by adding the lengths, in chains, of its north and south boundaries.*

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In the 1973 BLM Manual

9-25. *For example, taking section 30, shown on the specimen plat, the dimensions of the latitudinal boundaries and the areas are found as follows:*

	(1)	(2)	(3)	(4)
N	18.21	18.245	18.28	18.315 chs.
S	18.245	18.28	18.315	18.35 chs.
	36.455	36.525	36.595	36.665 acres
	36.45(+)	36.53(-)	36.59(+)	36.67(-) acres



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Using the same methodology Section 5 is computed as follows:

$$(19.75 - 19.15) / 4 = 0.15$$

(1) (2) (3) (4)

E 19.15 19.30 19.45 19.60

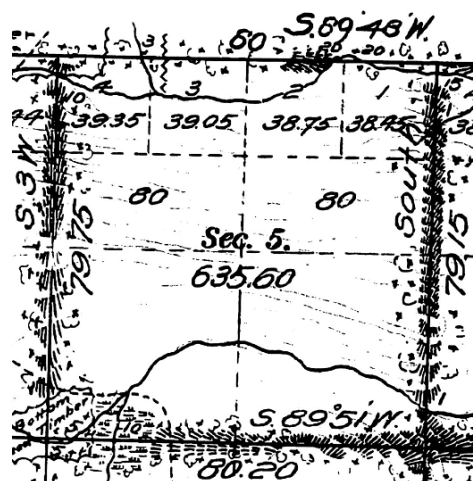
W 19.30 19.45 19.60 19.75

Acres 38.45 38.75 39.05 39.35

To proportion the CN1/16 corner use the parenthetical distance of 19.45 chains.

If the distance from the C1/4 to N1/4 is 2600.00 feet then the distance from C1/4 to CN1/16 = $2600.00 \times 20 / 39.45$ = 1318.12 feet.

Another way to get the answer:
 $(39.05 + 38.75) / 4 = 19.45$



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COMPUTATION OF AREAS FROM THE 1894 MANUAL

Example 1. (See Plate IV, section 31.)

The 1/4 difference of latitudinal boundaries is $0.15 / 4$ chains; consequently, "d" is .04 chains; then,

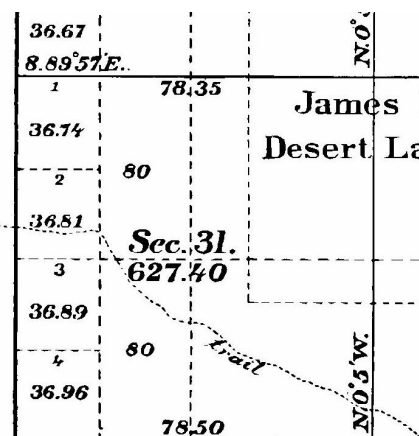
$18.35 \times 2 + .04 = 36.74$ acres, lot 1;

$18.50 \times 2 - .04 = 36.96$ acres, lot 4;

$18.50 + 18.35 - .04 = 36.81$ ac, lot 2;

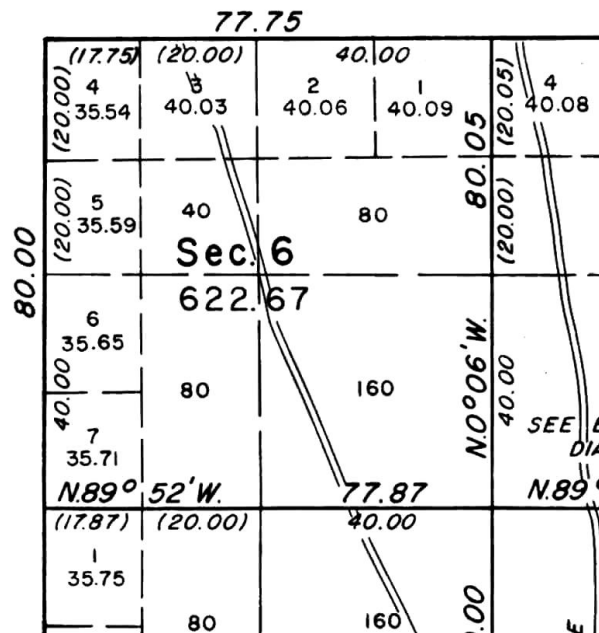
$18.50 + 18.35 + .04 = 36.89$ ac, lot 3;

Check: $[18.35 + 18.50] \times 4 = 147.40$ acres, the area of the four lots.



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Section 6 – A Special Case



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Computation of Areas in Section 6 in the 1973 BLM Manual

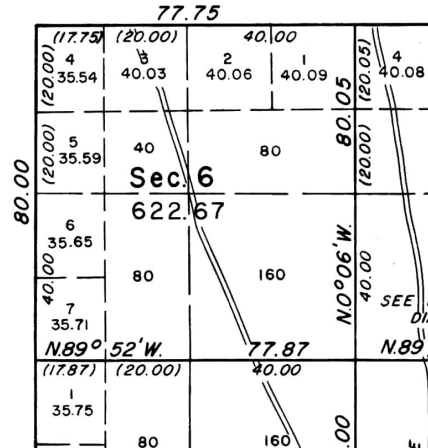
9-26. The areas of lots 5, 6, and 7, section 6, are ascertained similarly, making due allowance, when calculating the length of the north boundary of lot 5, for any material variation from 20.00 chains in the meridional dimension of lot 4.

9-28. The areas of lots 1, 2, and 3, section 6, are ascertained similarly, making due allowance when calculating the length of the west boundary of lot 3, for the departure across lot 4, where more or less than 20.00 chains. The area of lot 4, section 6, in acres, equals the product of its mean dimensions in chains, divided by 10.

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9-29. The following is an example of ascertaining the areas of the fractional lots in section 6, shown on the specimen township plat:

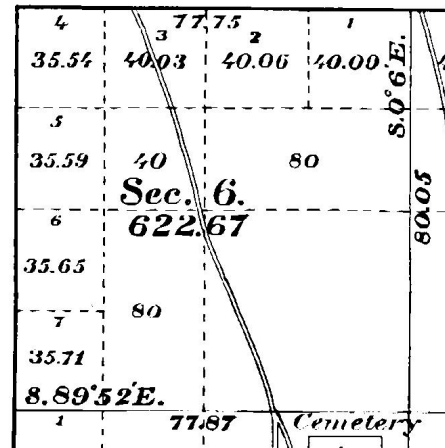
	(1)	(2)	(3)	(4)	
E	20.05	20.037	20.024	20.011	chs.
W	20.037	20.024	20.011	20.000	chs.
	40.087	40.061	40.035		acres
	40.09	40.06	40.03		acres
				20.005	mean
	(5)	(6)	(7)		
N	17.78	17.81	17.84	17.75	chs.
S	17.81	17.84	17.87	17.78	chs.
	35.59	35.65	35.71		acres
				17.765	mean
	$20.005 \times 17.765 / 10 = 35.539$				acres
	35.54				acres



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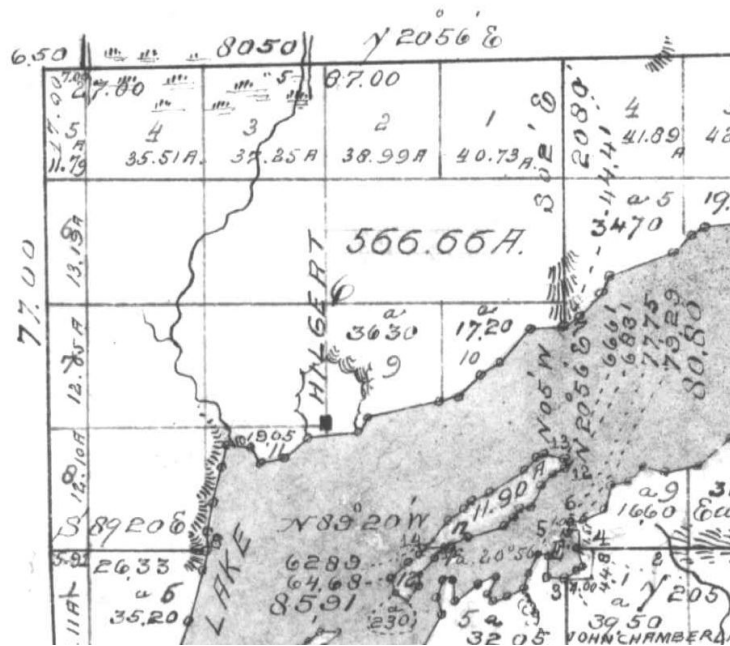
COMPUTATION OF AREAS FROM THE 1894 MANUAL

chs.	chs.	chs.	chs.
77.75 :	0.05 ::	60.000 :	0.0386 = q
1/3 q =	0.0129	chs.	
chs.	chs.	chs.	
20.0500 - 0.0386	=	20.01, the E. bdy. of lot 4;	
20.0114 + 0.0129	=	20.02, the E. bdy. of lot 3;	
20.0243 + 0.0129	=	20.04, the E. bdy. of lot 2.	
Then, for the areas of lots 1, 2, 3, and 4, we have:			
chs.	chs.	acres	
20.05 + 20.04	=	40.09, the area of lot 1;	
20.04 + 20.02	=	40.06, the area of lot 2.	
20.02 + 20.01	=	40.03, the area of lot 3;	
$\frac{20.00 + 20.01}{2}$	$\times \frac{17.75 + 17.78}{2}$	=	35.54, lot 4.



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Subdivide Section 6, T17N, R5E



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Subdivide Section 6

- The missing parentheticals needed to subdivide the section:
 - The record distance between lots 2 and 3
 - This distance will enable the proportioning of the CN 1/16th corner.
 - The record distance between lots 6 and 7
 - This distance will enable the proportioning of the CW 1/16th corner and the C-80 1/16th corner.

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Calculate parenthetical lots 2 and 3

- 1) Using areas of Lots 2 and 3:
 $(37.25 + 38.99) / 4 = 19.06$ chains between Lots 2 and 3.
 - 2) Using areas starting with east boundary of Lot 1:
 $40.73 - 20.80 = 19.33$ chains between Lots 1 and 2;
 $38.99 - 19.33 = 19.06$ chains between Lots 2 and 3.
 - 3) Proportioning distances between east line of Lot 1 and west line of Lot 5:
 $q = (20.80 - 17.00) \times (80 / 87.00) = 3.4943$ chains change from east line of lot 1 to the west line of lot 4;
 $20.80 - (q / 2) = 19.05$ chains between Lots 2 and 3.
 - 4) Mean distance of east line of Lot 1 and west line of Lot 5:
 $(20.80 + 17.00) / 2 = 18.90$ chains between Lots 2 and 3.
- Best answer: 19.06 chains between Lots 2 and 3.

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Calculate parenthetical lots 6 and 7

- 1) Using areas of Lots 6 and 7:
 $(13.19 + 12.65) / 4 = 6.46$ chains between Lots 6 and 7.
 - 2) Using areas starting with south boundary of Lot 8:
 $12.10 - 5.91 = 6.19$ chains between Lots 7 and 8;
 $12.65 - 6.18 = 6.46$ chains between Lots 6 and 7.
 - 3) Proportioning distances between south line of Lot 8 and north line of Lot 5:
 $q = (7.00 - 5.91) \times (60 / 77.00) = 0.8494$ chains change from the south line of lot 8 to the north line of lot 6;
 $5.91 + (2q / 3) = 6.48$ chains between Lots 6 and 7.
 - 4) Mean distance of south line of Lot 8 and north line of Lot 5:
 $(5.91 + 7.00) / 2 = 6.455$ chains between Lots 6 and 7.
- Best answer: 6.46 chains between Lots 6 and 7.

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GLO Plat T18N, R10W 1884

Calculation using 1894 Method:

$$q = (60/72.50) \times 1.72 = 1.423$$

$$1/3 q = 0.474$$

$$\text{Lot 1} = 21.72 + 21.72 - 1/3q = 42.97$$

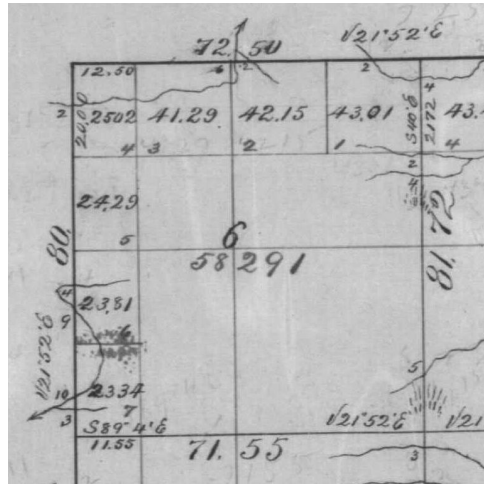
$$\text{Lot 2} = 21.72 - 1/3q + 21.72 - 2/3q = 42.02$$

$$\text{Lot 3} = 21.72 - 2/3q + 21.72 - q = 41.07$$

$$\text{South line of lot 4} = 12.50 - (12.50 - 11.55)/4 = 12.26$$

$$\text{Lot 4} = \{[(12.50 + 12.26) / 2] \times [(20 + 21.72 - q) / 2]\} / 10 = 24.94$$

This is not how the acreages were calculated.

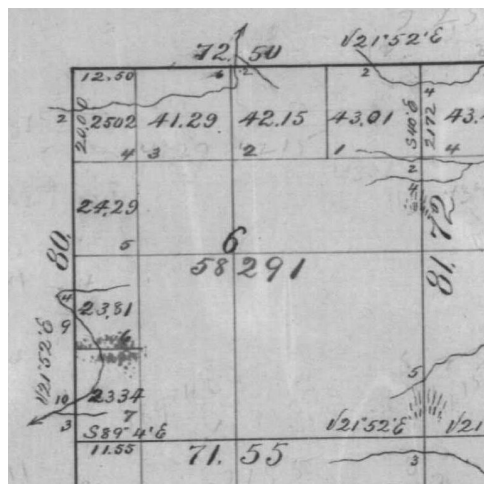


41

GLO Plat T18N, R10W 1884

The GLO/BLM formulas do not work here.

If the GLO plat is earlier than about 1885 then the method described in the 1894 Manual doesn't work and shouldn't be used to subdivide the section.



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GLO Plat T18N, R10W 1884

This is how the acreages were really calculated.

$$D = 1.72 / 4 = 0.430$$

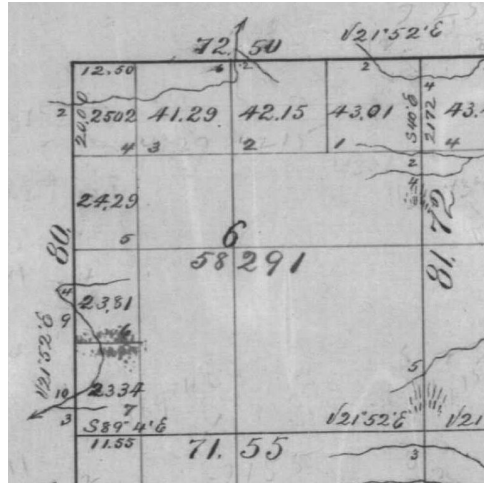
$$\text{Lot 1} = 21.72 + (21.72 - d) = 43.01$$

$$\text{Lot 2} = (21.72 - d) + (21.72 - 2d) = 42.15$$

$$\text{Lot 3} = (21.72 - 2d) + (21.72 - 3d) = 41.29$$

$$\text{South line of lot 4} = 12.50 - (12.50 - 11.55)/4 = 12.26$$

$$\text{Lot 4} = \{[(12.50+12.26) / 2] \times [(20 + 21.72 - 3d) / 2]\} / 10 = 25.026$$



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GLO Plat T18N, R10W 1884

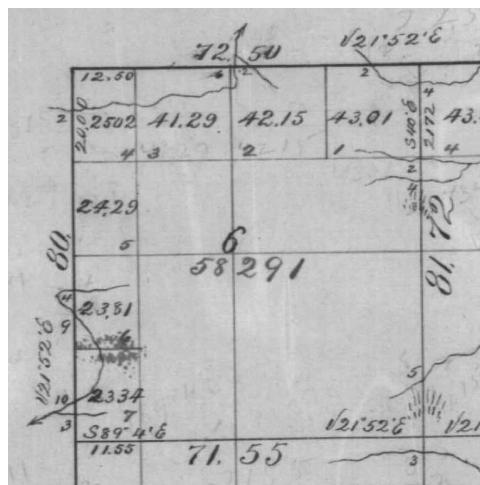
Calculate the parenthetical distance between lots 2 and 3.

$$d = 1.72 / 4 = 0.430$$

The parenthetical distance
between lots 2 and 3 = 21.72
– 2d = 20.86.

Alternate calculation:

$$(41.29 + 42.15) / 4 = 20.86$$



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GLO Plat T1N, R3E 1897

Calculation using the older method:

$$d = (24.80 - 23.80) / 4 = 0.250$$

$$\text{Lot 1} = 23.80 + (23.80 + d) = 47.85$$

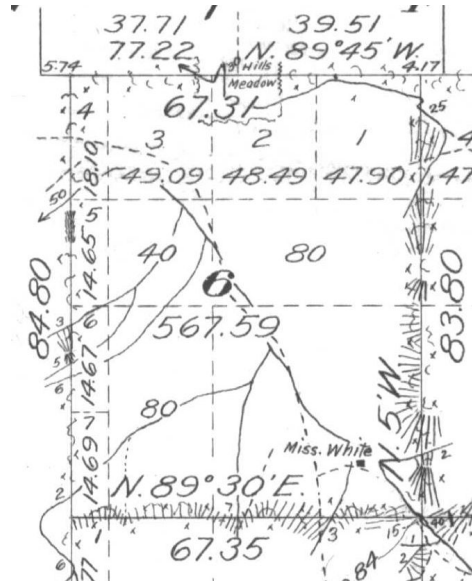
$$\text{Lot 2} = (23.80 + d) + (23.80 + 2d) = 48.35$$

$$\text{Lot 3} = (23.80 + 2d) + (23.80 + 3d) = 48.85$$

$$\text{South line of lot 4} = 7.31 - (7.35 - 7.31) / 4 = 7.32$$

$$\text{Lot 4} = \{[(7.31 + 7.32) / 2] \times [(24.80 + 23.80 + 3d) / 2]\} / 10 = 18.05$$

The acreages were not calculated by the old method.



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GLO Plat T1N, R3E 1897

Here the acreages were calculated using the method shown in the 1894 manual.

$$q = (60/67.31) \times (24.80 - 23.80) = 0.891$$

$$1/3 q = 0.297$$

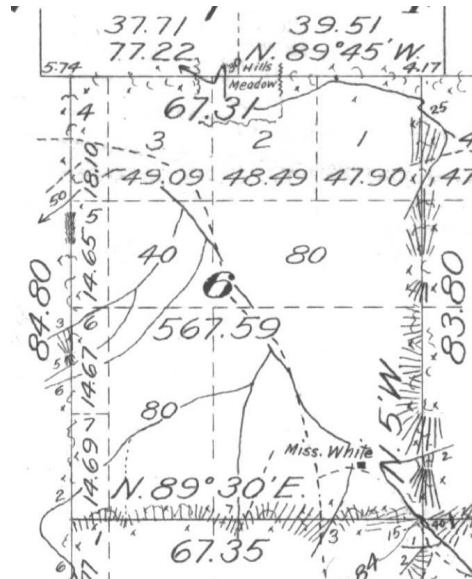
$$\text{Lot 1} = 23.80 + 23.80 + 1/3 q = 47.90$$

$$\text{Lot 2} = 23.80 + 1/3 q + 23.80 + 2/3 q = 48.49$$

$$\text{Lot 3} = 23.80 + 2/3 q + 23.80 + q = 49.09$$

$$\text{South line of lot 4} = 7.35 - \{(7.35 - 7.31) \times 60 / 84.80\} = 7.32$$

$$\text{Lot 4} = \{[(7.31 + 7.32) / 2] \times [(24.80 + 23.80 + q) / 2]\} / 10 = 18.10$$



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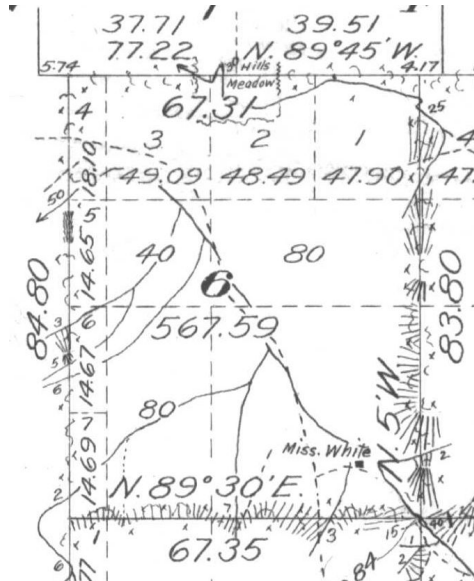
GLO Plat T1N, R3E 1897

Calculate the parenthetical distance between lots 2 and 3.

$$q = (60/67.31) \times (24.80 - 23.80) = 0.891$$

The parenthetical distance
between lots 2 and 3 = $23.80 + 2/3q = 24.394$.

The other way to calculate it =
 $(48.49 + 49.09) / 4 = 24.395$



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5-41. Closing Corners

(from the 1973 BLM Manual)

- *A lost closing corner will be reestablished on the true line that was closed upon, and at the proper proportional interval between the nearest regular corners to the right and left.*
- *A recovered closing corner not actually located on the line that was closed upon will determine the direction of the closing line, but not its legal terminus. The correct position is at the true point of intersection of the two lines.*
- *When an original closing corner is recovered off the line closed upon and the new monument is established at the true point of intersection, the original position will control in the proportionate restoration of lost corners dependent upon the closing corner.*
- *In a like manner the positioning of sixteenth-section corner(s) or lot corner(s) on the closing line, between the quarter-section corner and the closing corner, will be based on the measurement to the original closing corner.*

48

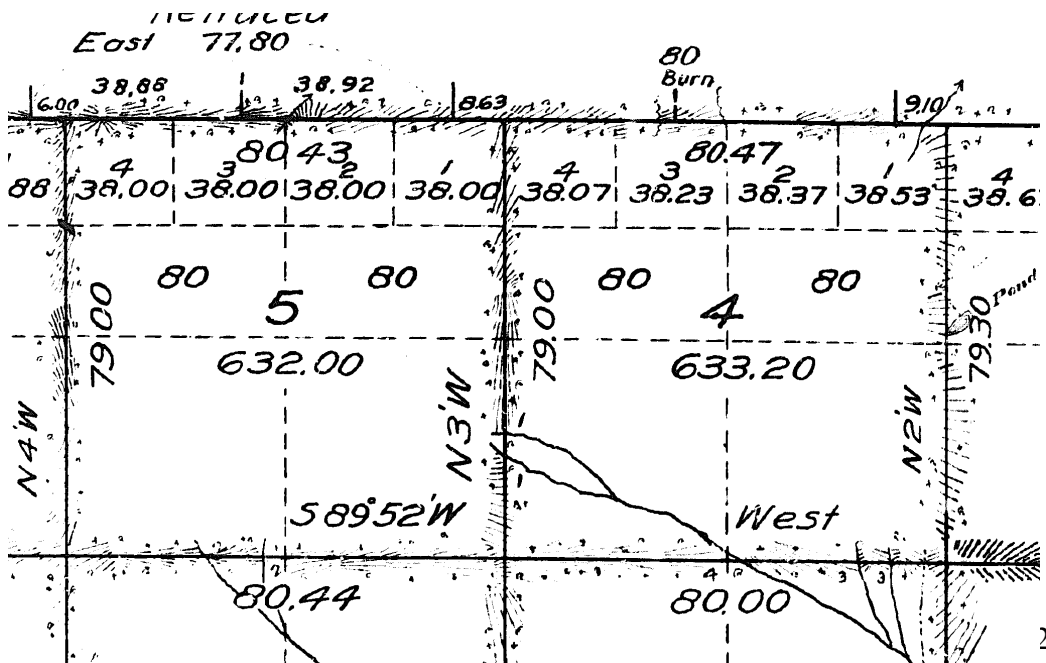
[illegible]

Quarter Corner not set by the GLO

- Closing sections to the south of a Standard Parallel normally will not have north 1/4 corners that were set by the GLO. The local surveyor must establish the North 1/4 corner and the Center North 1/16 corner. There are different opinions as to the correct procedure for establishing both corners.
- The Oregon office of the BLM advises that the following is the recommended procedure. The 1/4 corner is to be set at a proportionate point longitudinally between the true points for the closing corners, not between the original closing corners, and at a point latitudinally on the true standard parallel.
- The C-N 1/16 corner is set at a proportionate position between the North 1/4, as established on the standard parallel, and the Center 1/4 corner.

51

North 1/4 Corners Not Set in Original Survey



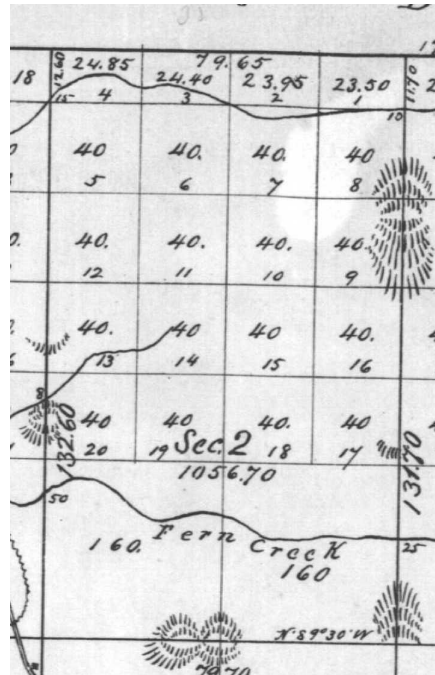
Elongated Section 2, T12N, R7W

An elongated section is subdivided in a manner similar to other closing sections.

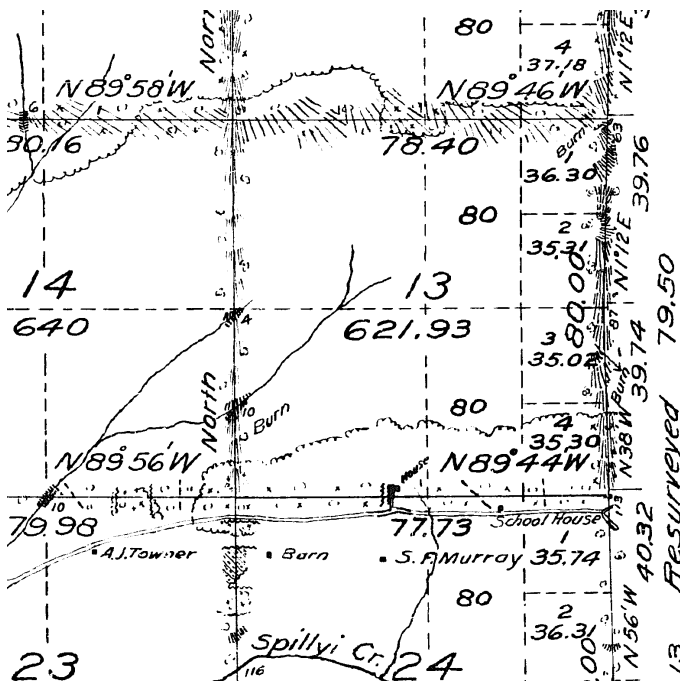
The 1/16 corners are proportioned along the section lines and section center lines and then connected with straight lines.

The 1/16 corners interior to the 1/4 section are at the intersection points.

Note that the northwest corner of lot 1 connects to the southwest corner of lot 17 with one straight line.

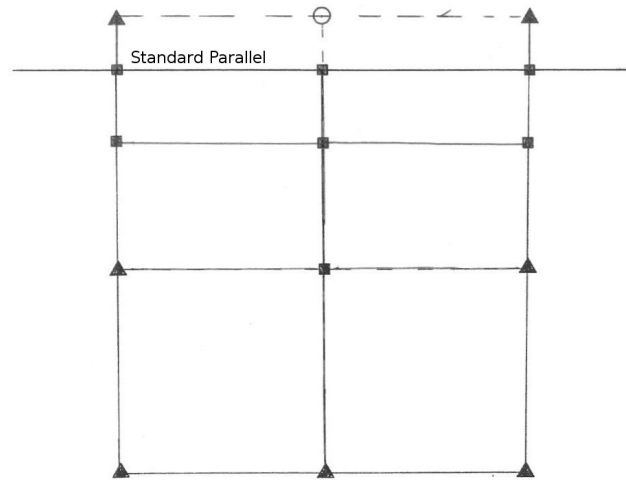


A Closing Section against an Irregular Range Line, Plat of Section 13, T6N, R3E, W.M.



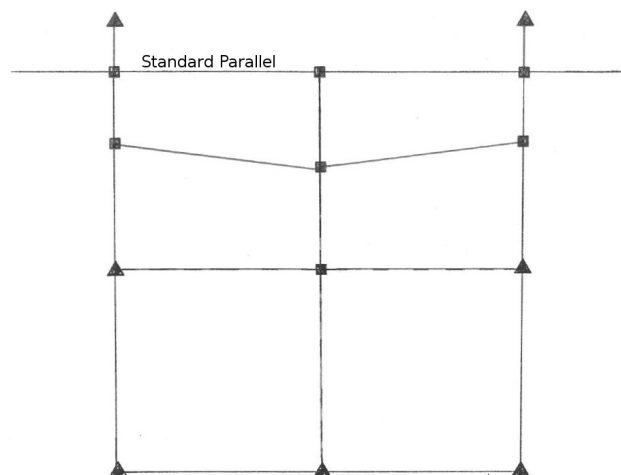
See page 50 of the Section Subdivision document for a demonstration of how to calculate the parenthetical distances against an irregular range line.

Subdivide and then Truncate or Extend Method



57

Truncate or Extend and then Subdivide Method



58



59

Part 4: Subdivision of Fractional Sections



60

FRACTIONAL TOWNSHIP

As defined in the BLM Glossary

“A township containing less than 36 normal sections, usually because of invasion by a segregated body of water, or by other land which cannot properly be surveyed as part of that township or by closing the public-land surveys on State boundaries or other limiting lines. Half ranges and half townships are fractional townships by definition.”

61

FRACTIONAL SECTION

As defined in the BLM Glossary

“A section, which in its original form, contained one or more subdivisions of less than forty (40) acres due to irregular exterior boundaries, or due to the encroachment of a meandered body of water or other land which could not properly be surveyed or disposed of as an aliquot part of that section.”

62

The Act of February 11, 1805 has an implicit definition of a fractional township

“But in those portions of the fractional townships, where no such opposite corresponding corners have been or can be fixed, the said boundary lines shall be ascertained, by running from the established corners, due north and south, or east and west lines, as the case may be, to the water-course, Indian boundary line, or other external boundary of such fractional township.”

63

In 1831 Gideon Fitz, in writing Instructions for Surveying in Mississippi, defines a Fractional Section.

“Fractional Sections are occasioned by Indian boundaries, District boundaries, State boundaries, navigable water courses, and individual or private claims. On navigable water courses, the sections may retain their square form, and yet become fractional, because part of the area of such sections, are taken out by such water course; and the parts of such sections are separated, and may not be connected by their boundaries continuing on the same right line across such stream, nor is it necessary that the lines in such situations should be continued directly across such navigable streams, because the fractional part of such sections on opposite sides of such streams, have their areas determined independent of each other.

Fractional sections, in the meaning of the law, are not occasioned by the section containing more or less than 640 acres, but become fractional only in situations as above mentioned, on navigable water courses, Indian boundaries, district, or State boundaries, and by individual claims.”

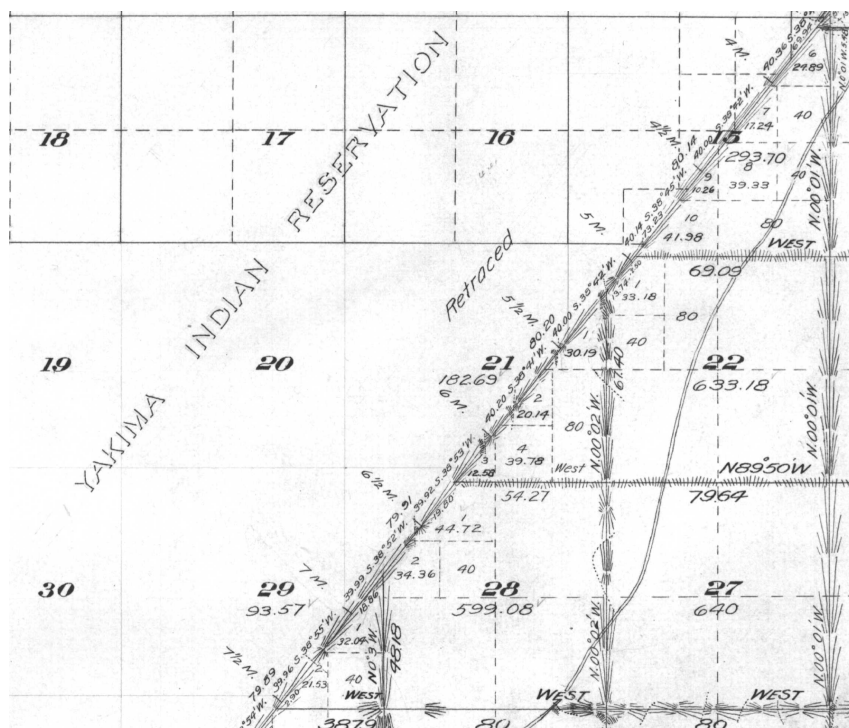
64

Things which make Fractional Sections

- (1) A Reservation or Grant
- (2) A Meandered Body of Water
- (3) A Patented Tract
- (4) An Uncompleted Survey
- (5) A State Boundary

65

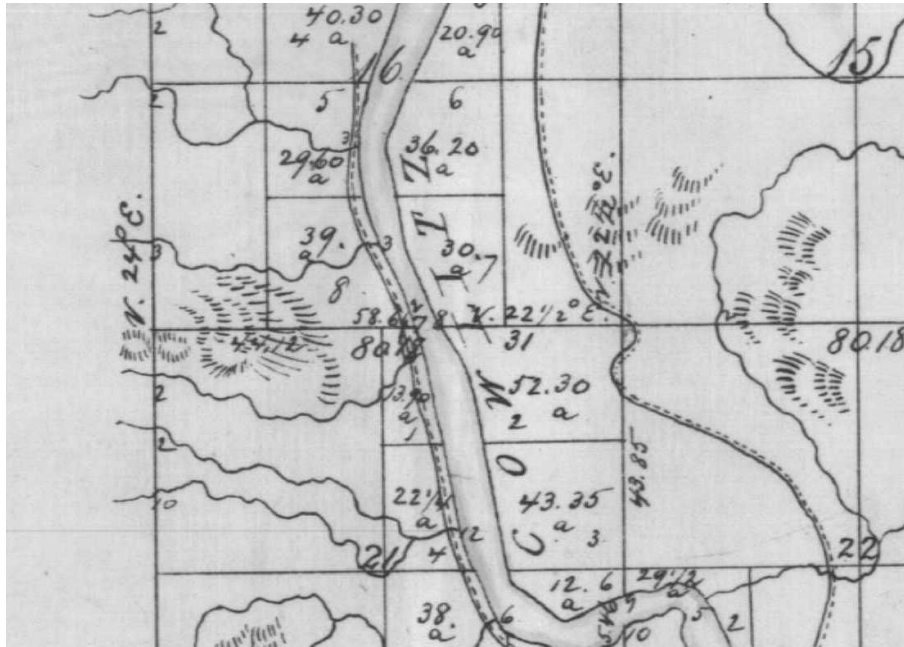
A Reservation or Grant



66

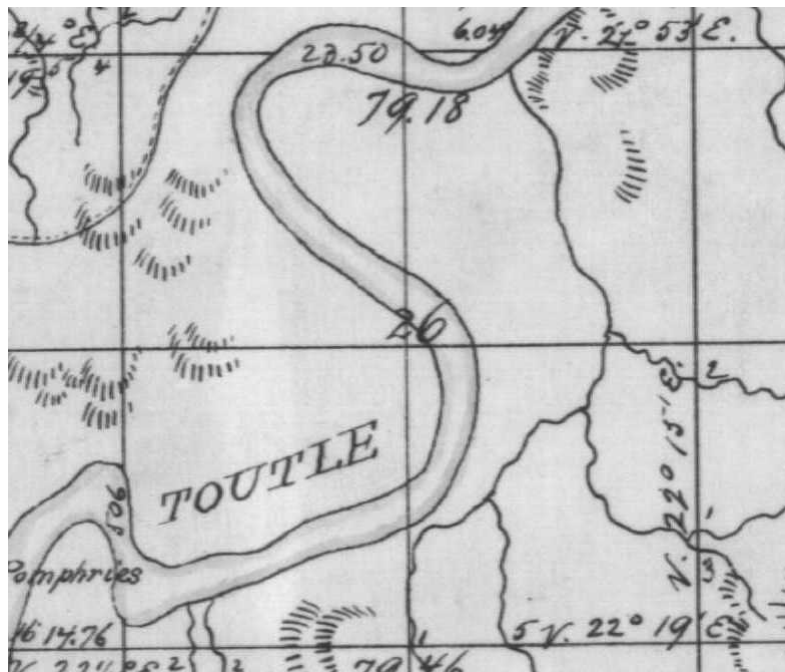
A Meandered Body of Water

Note that the section lines are measured across the river and the section, though fractional, was surveyed as a whole with all of the exterior lines measured in their entirety.



67

Not a Fractional Section – Not Meandered

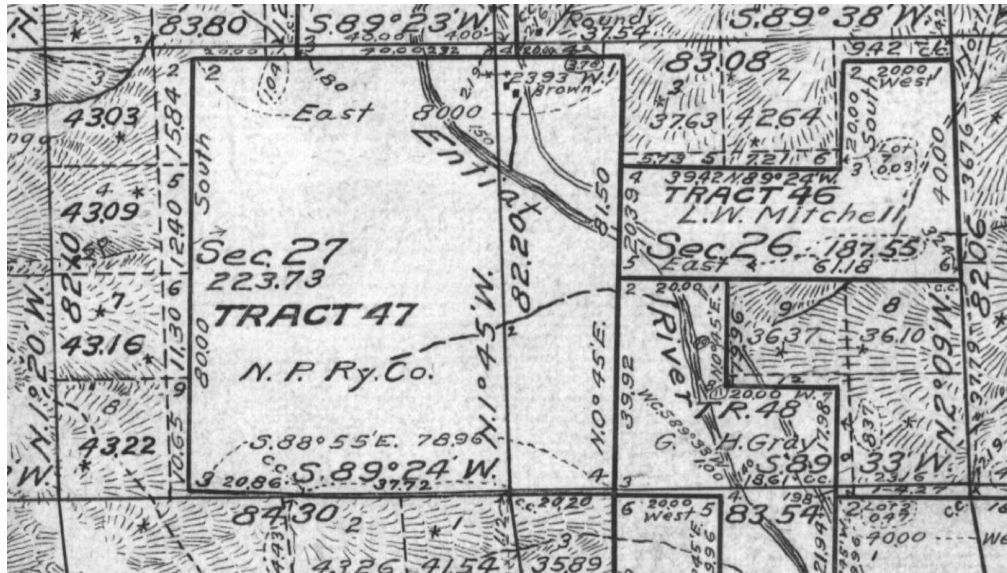


68

Here each side of the river was surveyed independently and both fractional parts of section 25 must be subdivided independently.

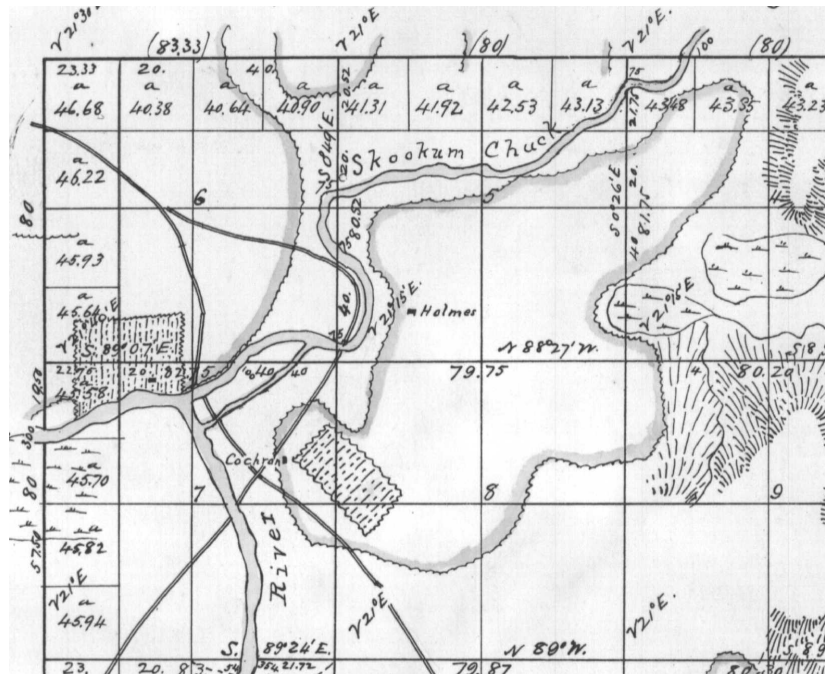


A Patented Tract



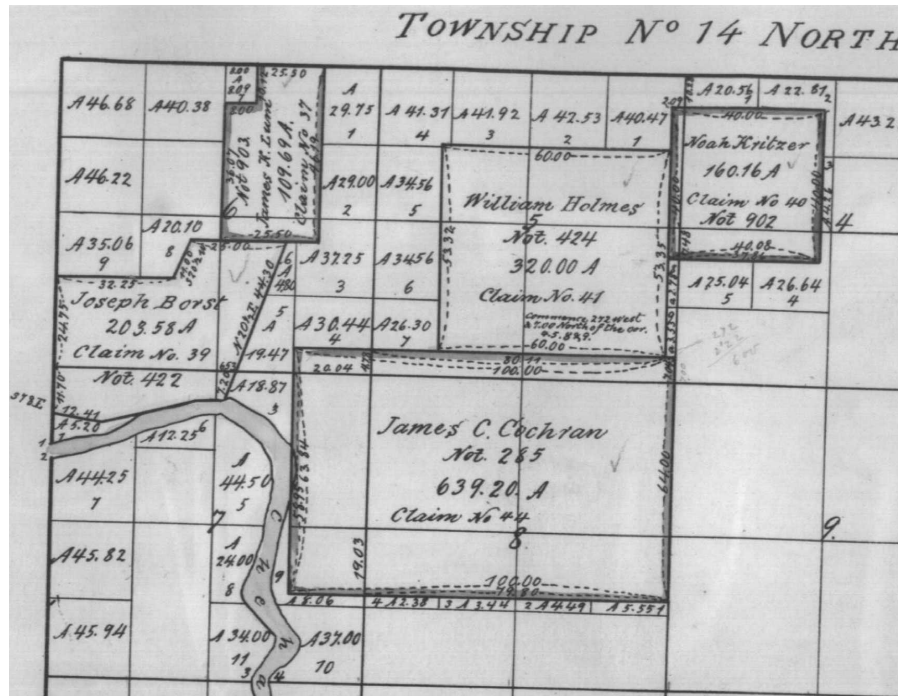
71

The sections were surveyed first and then the DLC's were cut out. One does not ordinarily use mean or parallel bearings to subdivide sections made fractional by DLC's.



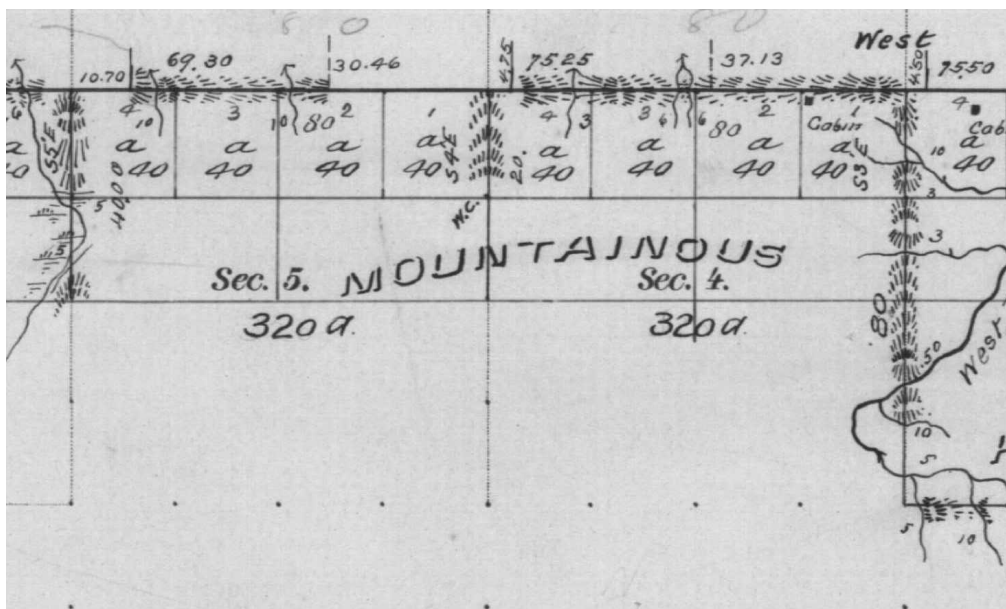
72

Donation Land Claims



73

An Uncompleted Survey



74

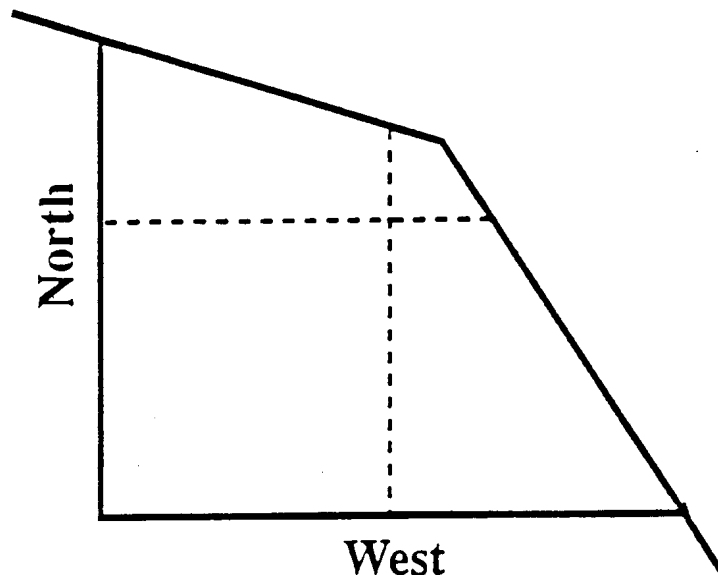
Subdivision of Fractional Sections

BLM Manual 3-88.

- *The law provides that where opposite corresponding quarter-section corners have not been or cannot be fixed, the subdivision of section lines shall be ascertained by running from the established corners north, south, east, or west, as the case may be, to the water course, reservation line, or other boundary of such fractional section, as represented upon the official plat.*
- *In this the law presumes that the section lines are due north and south, or east and west lines, but usually this is not the case. Hence, in order to carry out the spirit of the law, it will be necessary in running the center lines through fractional sections to adopt mean courses where the section lines are not on due cardinal, or to run parallel to the east, south, west, or north boundary of the section, as conditions may require, where there is no opposite section line.*

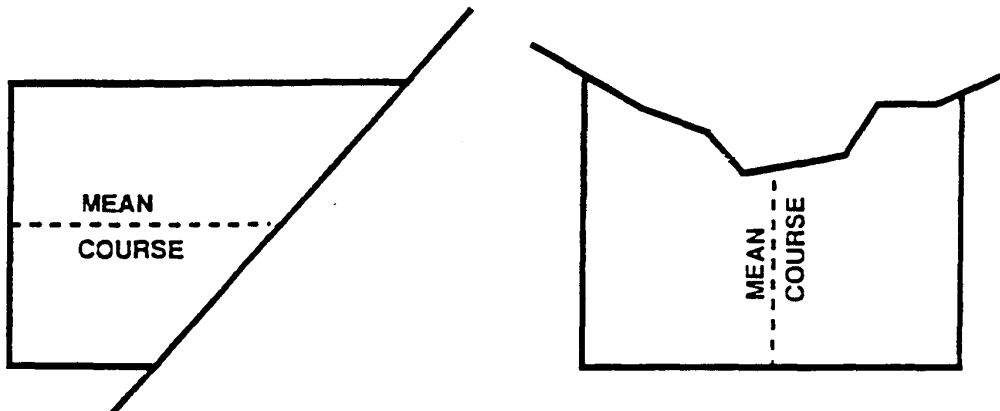
75

Where opposite section lines do not exist section centerlines are parallel to the section lines.



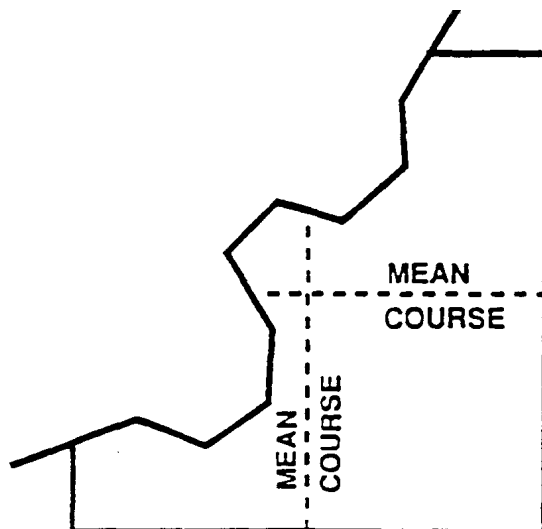
76

Subdivisions where one of the quarter section corners does not exist.
The corresponding subdivision line will be run on a mean course.



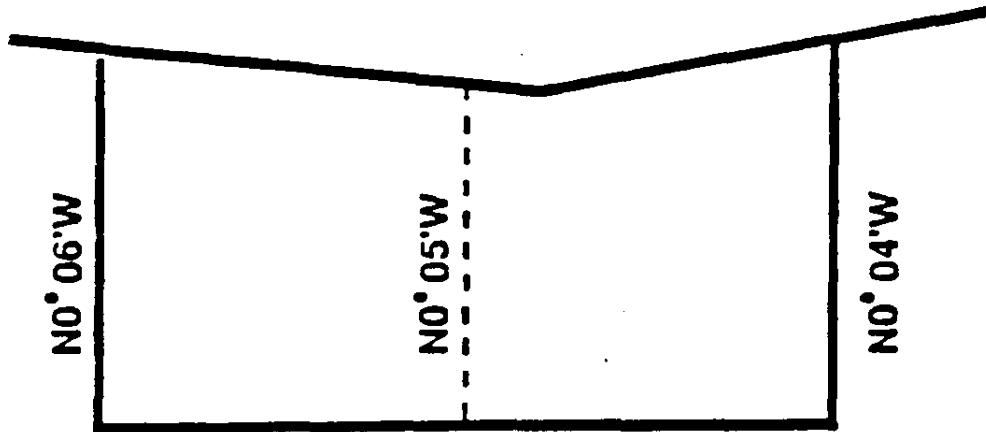
77

Where two adjacent quarter section corners do not exist, but portions of all exteriors exist, mean courses will be adopted.



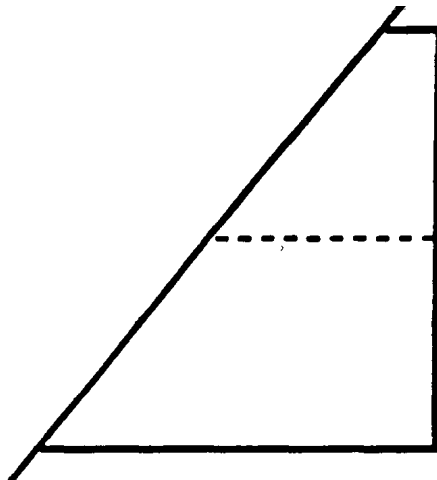
78

Arithmetic Mean is a mean of the sums of opposite section lines. This method was used at times in the past but is not the accepted method at present.



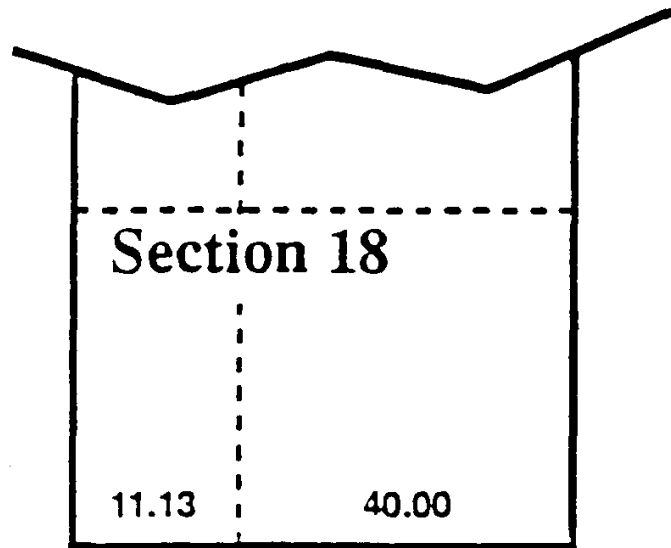
79

Weighted Mean. Opposite section lines differing greatly in length. A mean is developed in ratio to the lengths of opposite section lines. This is the currently accepted method.



80

Centerline not centrally located within section.
Mean is developed in ratio to the uncentered
relationship of the centerline.

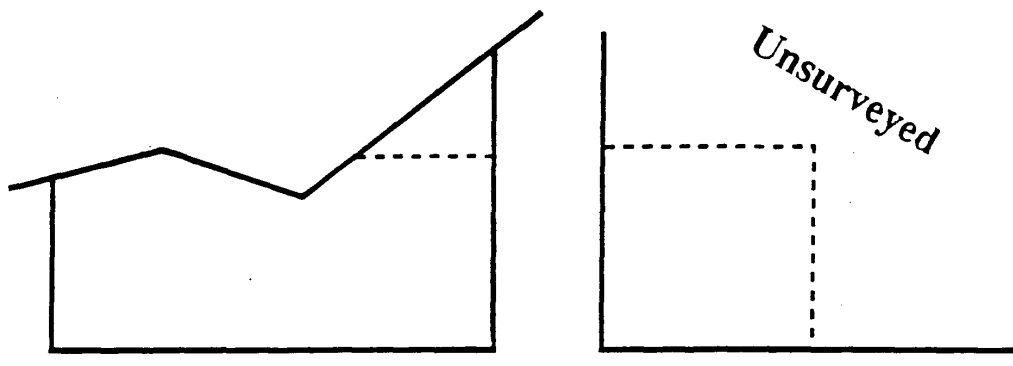


81

Subdivisions involving non-existent quarter section corners where there are no opposite section lines can occur:

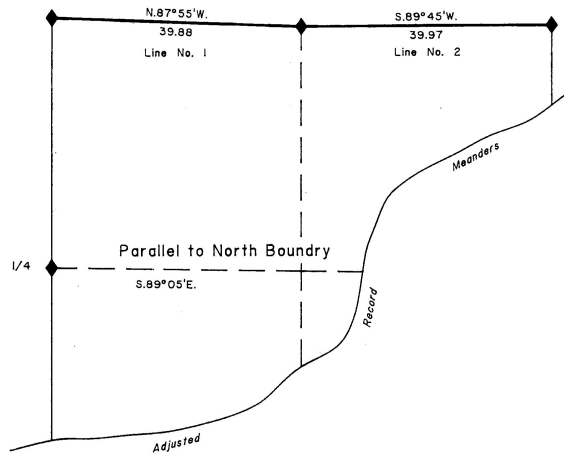
- Against fixed and limiting boundaries
- Against meanderable water courses
- Where surveys are incomplete

Generally, parallel lines will be adopted in running subdivision lines.



When you run parallel to a section line, the bearing is the mean bearing of the section line, which is the same as the inverse between the corners at the ends of the section line.

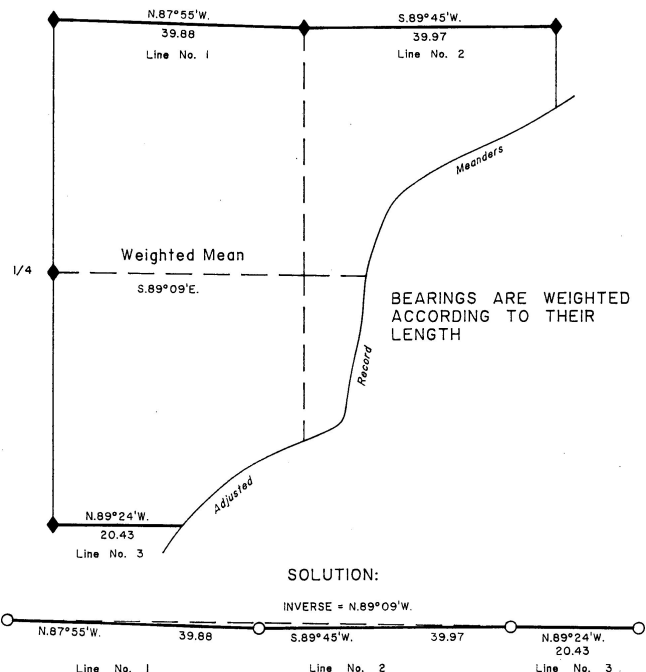
EXAMPLE: PARALLEL TO SECTION LINE



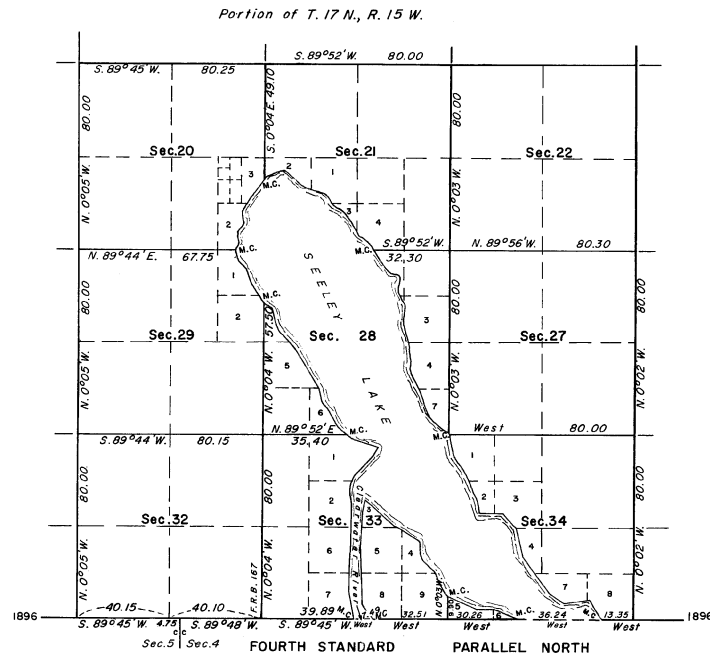
83

EXAMPLE: WEIGHTED MEAN BEARING

A weighted mean bearing is most easily computed by an inverse of all the courses of the two opposite section lines.

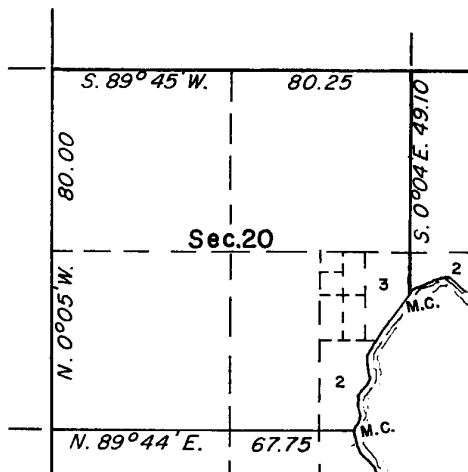


Seeley Lake – Combined Survey Record from the BLM Casebook



85

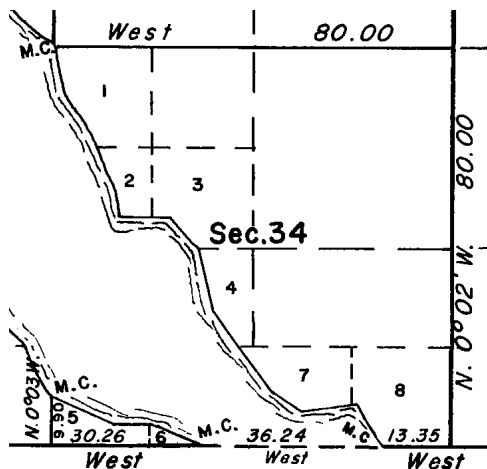
Seeley Lake - Section 20



In section 20, the record meanders were retraced and closing error adjusted by the broken boundary method (compass rule.) The centerlines of the section and centerlines of the NE $\frac{1}{4}$, SW $\frac{1}{4}$ and NW $\frac{1}{4}$ were surveyed between opposite corners in the normal procedure. The N-S centerline of the SE $\frac{1}{4}$ was surveyed normally. The E-W centerline of the SE $\frac{1}{4}$ was surveyed easterly on a mean bearing between the E-W centerline of the section and easterly portion on the south boundary of the section and terminated at a special meander corner on the adjusted original meander line. All minor subdivisional lines were run on calculated courses and distances. All 1/16 section corners were monumented. Only necessary minor subdivision corners were monumented.

86

Seeley Lake - Section 34



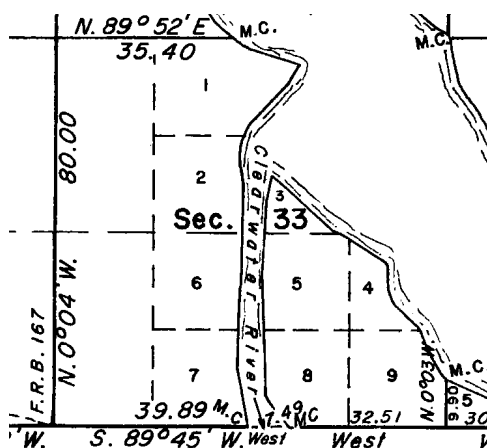
The N-S centerline of section 34 was surveyed southerly on a bearing parallel to the mean bearing of the east boundary of the section. The E-W centerline was surveyed westerly on a bearing which was a mean between the mean bearings of the north and south boundaries of the section. The center $\frac{1}{4}$ section corner was established at the intersection of the centerlines.

Based on the resurvey of the south, east and north boundaries of section 34, the record meanders were adjusted by calculation, using the compass rule and the first two calculated courses run on the ground.

The N-S centerline of the SE $\frac{1}{4}$ of section 34 was surveyed southerly on a mean bearing between the N-S centerline and the south half of the east boundary of the section to an intersection with the calculated adjusted meander line, where a special meander corner was established.

The E-W centerline of the NE $\frac{1}{4}$ of section 34 was surveyed on a connecting course.

Seeley Lake - Section 33



In section 33, all of lots 1 thru 9 are in the National Forest. The portion of the Standard Parallel between Seeley Lake and the Clearwater River was not resurveyed, nor was the short line between sections 33 and 34. Section 33 has only one $\frac{1}{4}$ section corner.

The E-W centerline of section 33 was surveyed easterly on a mean bearing between the controlling north and south boundaries of the section, with the C-W $\frac{1}{16}$ section corner established at a mean distance. The N-S centerlines of the SW $\frac{1}{4}$ and NW $\frac{1}{4}$ were then surveyed, resulting in bearings which were (coincidentally) parallel to the west boundary of the section.

The E-W centerlines of the NW $\frac{1}{4}$ and SW $\frac{1}{4}$ sections were surveyed on mean bearings, easterly to intersections with the N-S centerlines of those $\frac{1}{4}$ sections and the NW $\frac{1}{16}$ and SW $\frac{1}{16}$ section corners established. The minor subdivision-of-section lines were surveyed on connecting courses or calculated courses and distances.

[illegible]

96 WEST 79.90 N.89°

N.0°0' N.0°

80.00 80.00

40 40

80 80

1 2

25.75 25.13

Sec. 33
568.59
Clear Lake

4 3

21.77 15.94

80 80

40 40

80.00

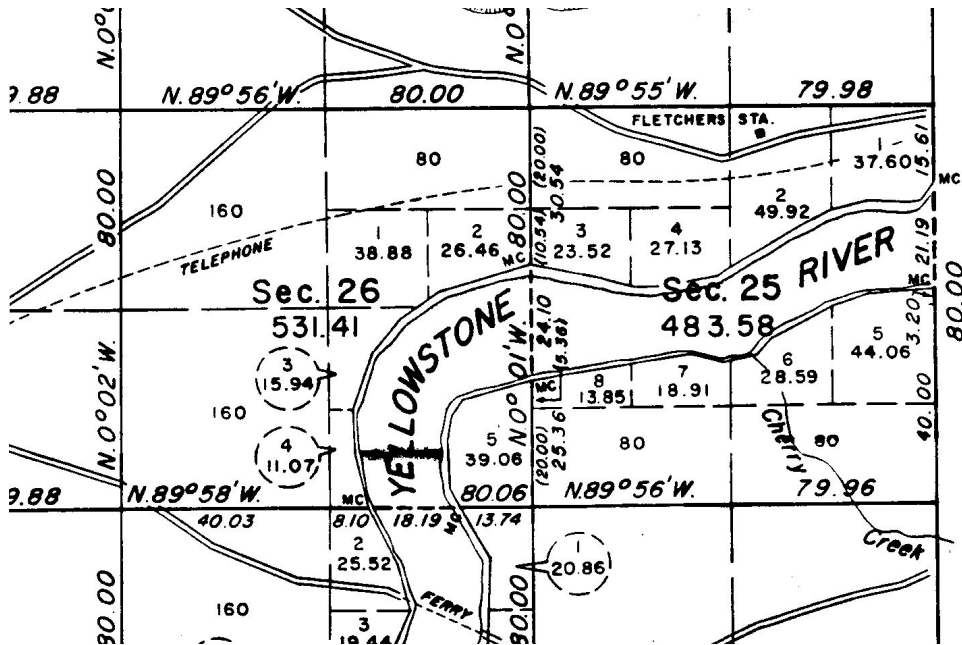
N.0°04'W. N.0°03'W.

Cr.

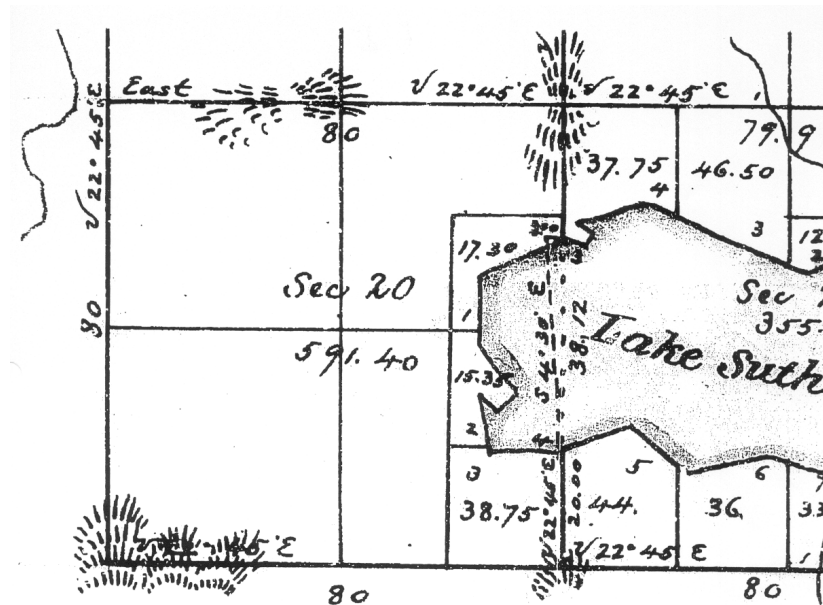
S.89°57'E.

90

From the BLM Sample Plat



The situation of a Quarter Corner which has existing Section Corners on both sides but wasn't set because it fell in a Lake or River.



EAST QUARTER CORNER SECTION 20

CALCULATED CORNER

EVIDENCE FOUND:

-NONE, THIS CORNER WAS NOT SET BY THE ORIGINAL GLO SURVEY AS IT FALLS IN LAKE SUTHERLAND.

CORNER COMPUTATION:

-THIS POSITION MUST BE CALCULATED IN ORDER TO SUBDIVIDE SECTION 20. TO DATE, TWO METHODS HAVE BEEN USED BY PRIVATE SURVEYORS.

-IN A LETTER DATED MARCH 3, 1959 BY J.U. WRIGHT PLS 4233 TO THE BUREAU OF LAND MANAGEMENT, WRIGHT ASKED FOR AN ADVISORY OPINION REGARDING THE SUBDIVISION OF SECTION 20, AND THE CALCULATION OF THE EAST QUARTER CORNER.

-THE REPLY CAME FROM L.M. BERLIN, AREA CADASTRAL ENGINEERING OFFICER, U.S.B.L.M. ADVISING MR. WRIGHT THAT HIS OFFICE WOULD LIKELY CALCULATE A POSITION FOR THE CORNER AT A MID-POINT BETWEEN THE FOUND SECTION CORNERS AND IGNORE THE FOUND NON-TERMINAL MEANDER CORNERS FOR PROPORTIONING PURPOSES.

-IN 1959 J.U. WRIGHT PLS 4233 FOLLOWED THE ADVICE OF THE BLM FOR HIS WORK IN SECTION 20.

-IN 1963 G. ROATS PLS 4809 MADE A SUBDIVISION OF SECTION 20. ROATS ALSO PROPORTIONED THE EAST QUARTER CORNER OF SECTION 20. ROATS HELD THE FOUND MEANDER CORNERS FOR HIS WORK IN SECTION 20 INSTEAD OF THE SECTION CORNERS RESULTING IN A DRASTICALLY DIFFERENT POSITION FOR THE CORNER AND CONSEQUENTLY FOR THE LINES OF THE GOVERNMENT LOTS IN SECTION 20.

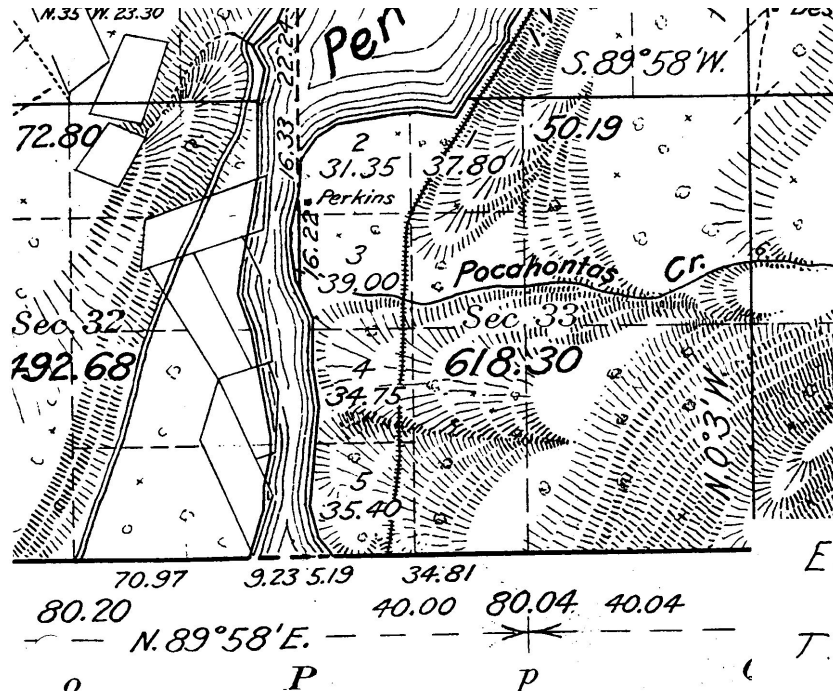
-A DISPUTE ENSUED BETWEEN PROPERTY OWNERS IN GOVERNMENT LOTS 2 AND 3; IN 1966 IN THE CLALLAM COUNTY COURT CAUSE NO. 15982 FIXED THE BOUNDARIES OF GOVERNMENT LOTS 2 AND 3 UTILIZING THE 1959 METHOD DESCRIBED ABOVE BY MR. BERLIN OF THE BLM AND USED BY J.U. WRIGHT PLS 4233.

-THE 1998 DNR SURVEY ACCEPTS THE 1966 CLALLAM COUNTY COURT CAUSE NO. 15982 AND J.U. WRIGHT'S PLS 4233 SUBDIVISION, WHICH CALCULATES THE EAST QUARTER CORNER OF SECTION 20 UTILIZING FIELD TIES TO THE NORTHEAST AND SOUTHEAST CORNERS FOR WORK PERFORMED IN SECTION 20 TOWNSHIP 30 NORTH, RANGE 8 WEST, W.M.

-SEE ALSO SURVEY VOLUME 29, PAGE 100 BY R.L. NESARY, PLS 22344.

93

Enclosure "D"



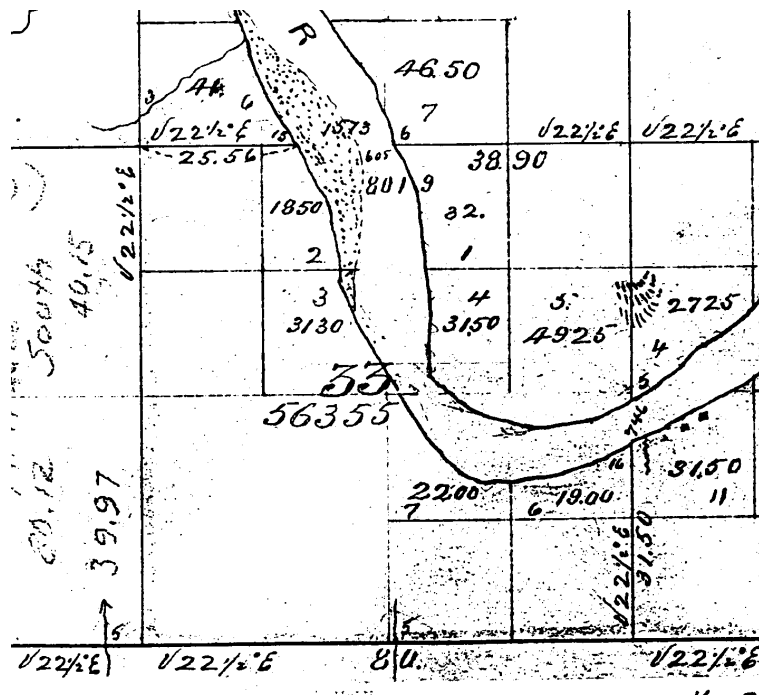
94

BLM Advice – Enclosure “D”

Enclosure "D" is of section 33, T. 39 N., R. 43 E., W.M., Wa. A private surveyor requested our advice for the subdivision of this section. This is a fractional section because the northwest section corner and west 1/4 section corner fall in the river and major portions of the north and west boundaries were not surveyed. The east and west center line is based on a weighted mean bearing of the resurveyed north and south section boundaries. The private surveyor found the original survey to have been performed accurately enough that he could calculate the proportionate position for the center W 1/16 section corner based on the meanders and lot areas. If the original survey had not been accurate enough to determine a proportionate basis, then the normal alternate procedure would have been to establish the center W 1/16 corner at 20 chs. from the center 1/4 corner.

95

Enclosure “E”



96

BLM Advice – Enclosure “E”

Enclosure “E” is of section 33, T. 35 N., R. 9 E., W.M., Wa. A private surveyor requested our advice for the subdivision of this section. He proposed surveying the north and south center line on a mean bearing because the north 1/4 section corner had not been “fixed” in the original survey. We advised that this was an acceptable procedure, but that in this case, he could consider establishing (fixing) the north 1/4 corner at proportionate distance between meander corners because the original surveyor measured across the river. He said that proportioning the 1/4 corner would actually be a better solution because it would result in better equity.

97

In the Case of a Fractional Section where all sides have been measured in their entirety and one or more quarter corners fall in a body of water that makes the section fractional.

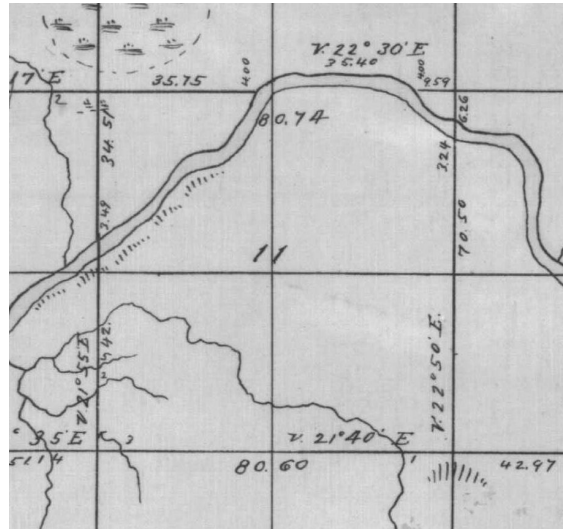
Two Options:

- Survey the section centerline using the fractional section method employing a true, mean or parallel bearing.
- Survey the section as a normal section by proportioning the quarter corner in the body of water.

98

Counterexample

A non-fractional section as shown below, with a missing quarter corner in a non-meandered body of water can only be surveyed by proportioning the missing quarter corner. Fractional section subdivision methodologies are not available. Why would one survey the section differently if the river had been meandered and the section were fractional?



99



100

[illegible]

Completion of Partially Surveyed Sections

When irregularity is developed, the simplest method of survey will correct irregularities and provide an early resumption of regularity in the new subdivisional lines is adopted. The general rule is that each completed section will have four regular boundaries without offsets, with four governing section corners and four controlling quarter-section corners in such position as to maintain the integrity of the fractional areas shown upon the original plat.

Rectangular Limits in the 1973 BLM Manual

BLM Manual 3-34. *The amounts by which a section, or its aliquot parts, may vary from the ideal section and still be considered regular are referred to as the rectangular limits:*

- (1) *For alinement, the section's boundaries must not exceed 21' from cardinal in any part, nor may the opposite (regular) boundaries of a section vary more than 21'.*
- (2) *For measurement, the distance between regular corners is to be normal according to the plan of survey, with certain allowable adjustments not to exceed 25 links in 40 chains.*

103

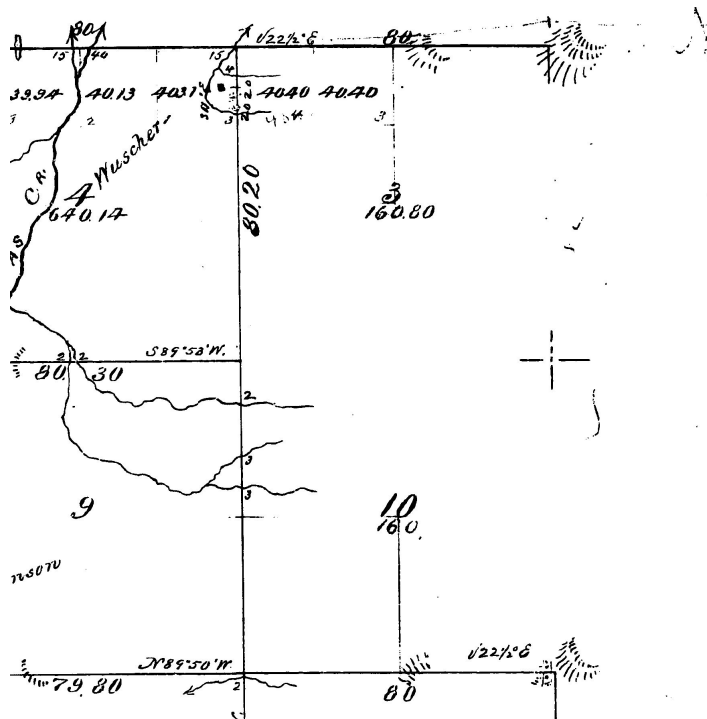
39 NORTH, RANGE NO. 4 East.

Example of a
Completion Survey
Illustrating the
significance of
Closing within Limits

This GLO Survey was
done in 1884 by
Iverson.

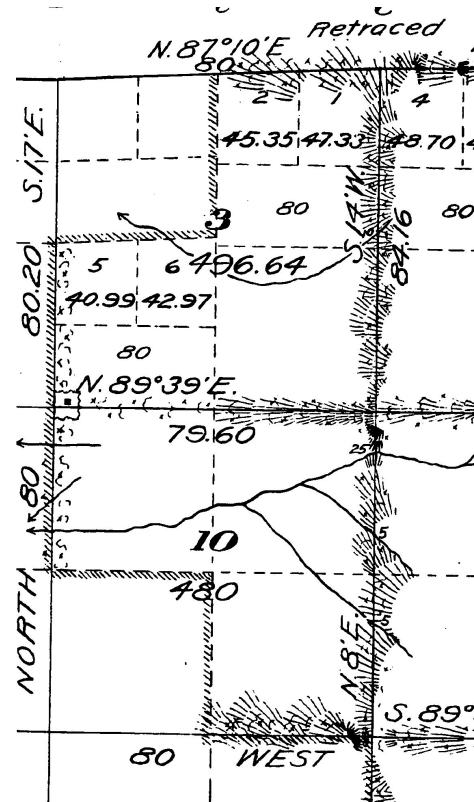
Note that Sections 3
and 10 are partial
sections.

Only the NW1/4 of
Section 3 exists and
only the SW1/4 of
Section 10 exists.



This is the
Completion Survey,
done in 1895 by
Galbraith.

The question is how
to subdivide Sections
3 and 10.



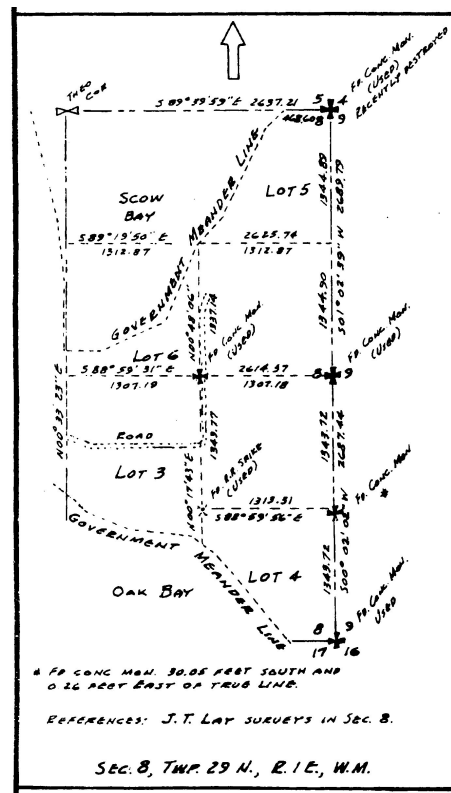
BLM Advice

The original areas within section 10 were returned from two separate surveys; the SW 1/4 from the 1884 survey by Iverson and the remainder of the section from the 1895 survey by Galbraith. Galbraith closed within limits against the first survey and therefore he was able to establish the 1/4 section corners on the north and east boundaries at positions that protected the previously returned areas by use of a normal (straight center lines) subdivision of section 10.

Contrary to the normal subdivision of section 10, is section 3. In section 3, Galbraith could not close within limits against the first survey and consequently had to retrace the north boundary. Galbraith's lotting shows that the southeast corner of the NW 1/4 would be established at the intersection of parallel lines to protect the previously returned areas. Galbraith's plat shows the areas returned from his survey are based on a second center 1/4 corner position.



Part 6: Subdivision by Protraction and Subdivision by Survey



SUBDIVISION BY PROTRACTION

Webster's New World Dictionary: "**protract** ... to draw to scale; using a protractor and scale"

3-74.... *The sections are not subdivided in the field by Bureau of Land Management cadastral surveyors unless provision is made in the special instructions, but certain subdivision-of-section lines are always protracted upon the official plat.*

3-79. *Sections which are invaded by meanderable bodies of water, or by approved claims at variance with the regular legal subdivisions, are subdivided by protraction into regular and fractional parts as may be necessary to form a suitable basis for the administration of the public lands remaining undisposed of, and to describe the latter separately from the segregated areas.*

109

SUBDIVISION BY SURVEY

3-85. *The rules for subdivision of sections by survey are based on the laws governing the survey of the public lands. Some cases arise, however, which are not covered by these rules and require the advice of the Bureau of Land Management. The letter of inquiry should contain a description of the particular tract or corner, with reference to township, range, and section of the public surveys, together with a diagram showing conditions found.*

110

CONFLICT BETWEEN 3-80 AND 3-88

SUBDIVISION BY PROTRACTION

3-80. ... In the case of a section whose boundary lines are in part within the limits of a meanderable body of water, or within the boundaries of a private claim, the fractional section lines are completed in theory, and the protracted position of the subdivision-of-section lines is controlled by the theoretical points so determined.

SUBDIVISION BY SURVEY

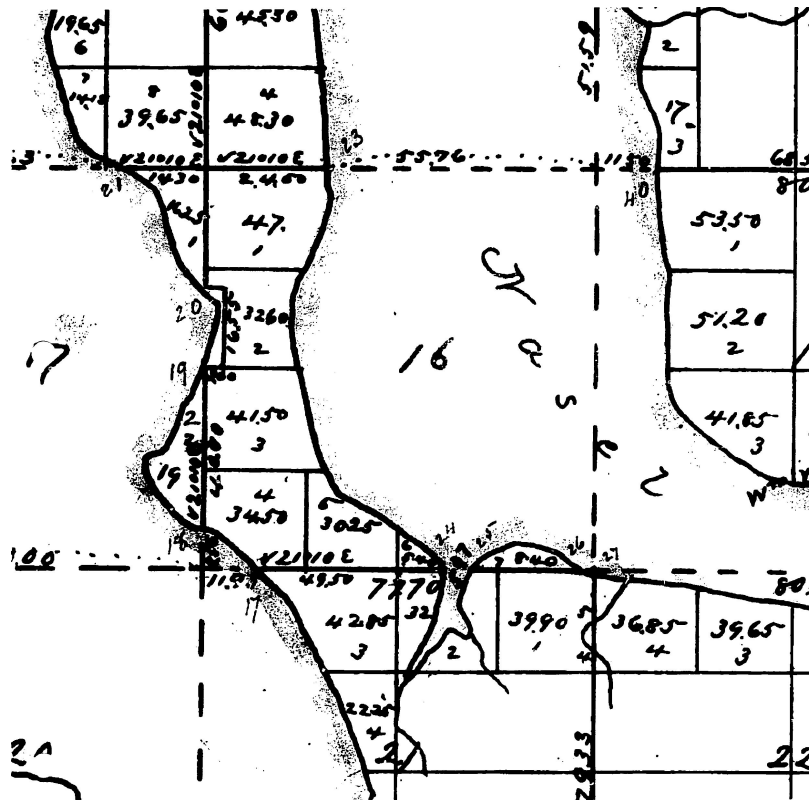
3-88.... Hence, in order to carry out the spirit of the law, it will be necessary in running the center lines through fractional sections to adopt mean courses where the section lines are not on due cardinal, *or to run parallel to the east, south, west, or north boundary* of the section, as conditions may require, where there is no opposite section line.

111

Resolution of the Conflict between Section Subdivision by Protraction and Section Subdivision by Survey

- Subdivision by Protraction is a batch of instructions for the drafting of a township plat. There is no basis in law for applying the methodology to a field survey.
- Subdivision by Survey is the method, based on federal statutes, for establishing boundaries of sections and parts of sections.

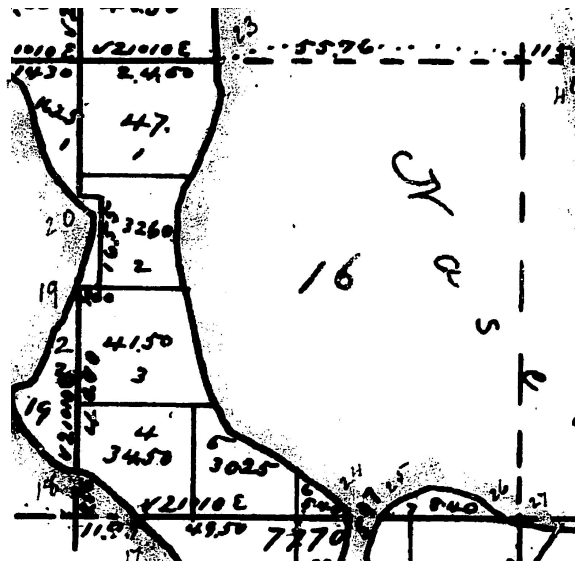
112



113

United States Department of the Interior

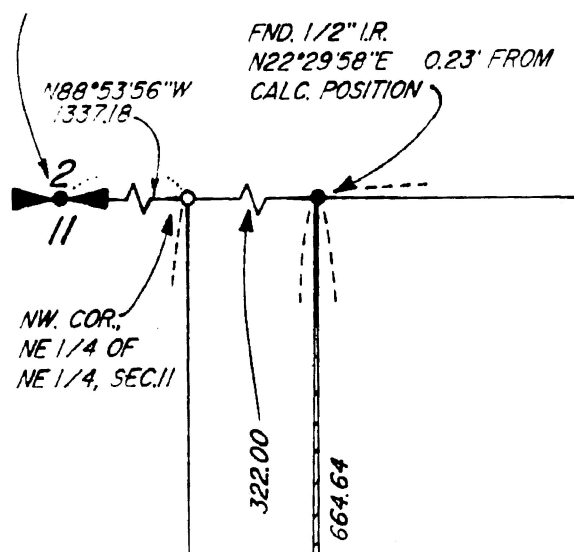
BUREAU OF LAND MANAGEMENT
OREGON STATE OFFICE
825 NE Multnomah Street
P.O. Box 2965
Portland, Oregon 97208



The section should be subdivided in the manner described in Section 3-88 of the Manual, "Subdivision of Fractional Sections". The north and south subdivisional lines should be run parallel to the mean bearing of the west boundary of the section. The east and west subdivisional lines should be run on a weighted mean bearing of the north and south boundaries.



Part 7: Theoretical Section Subdivision and Found Survey Monuments



The importance of local corners.

Manual 6.28. *Once it is accepted, a local point of control has all the authority and significance of an identified original corner. ... When a local reestablishment of a lost corner has been made by proper methods without gross error and has been officially recorded, it will ordinarily be acceptable.*

This section is interpreted, by this office (BLM Washington DC) to pertain both to the reestablishment of lost corners and to the establishment/reestablishment of minor subdivision corners.

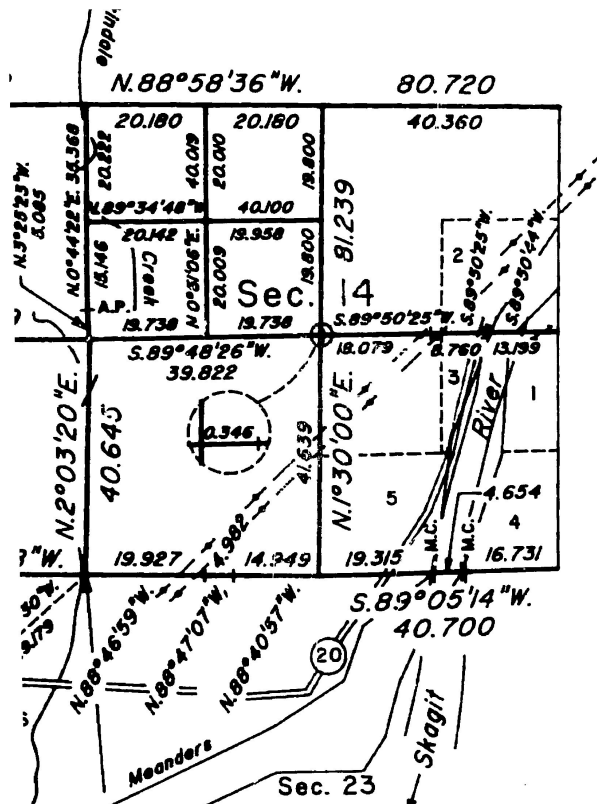
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The following guidelines should be used to help evaluate local corners for acceptance.

1. Was the corner established by a surveyor who was qualified to perform land surveys according to State regulations?
2. Is the record complete or are there ambiguities which cannot be satisfactorily resolved?
3. Was the corner established using proper control and proper procedures?
4. How long has the corner been in place and has it been relied upon by local landowners to mark their boundaries?
5. Has the corner been used by other surveyors?
6. Has the corner been used in deeds to convey land?
7. Are errors in positioning minor technical errors or gross error?
8. Is the Federal land public domain, reacquired, or reconveyed?
9. Can you defend your decision if challenged? On what basis?

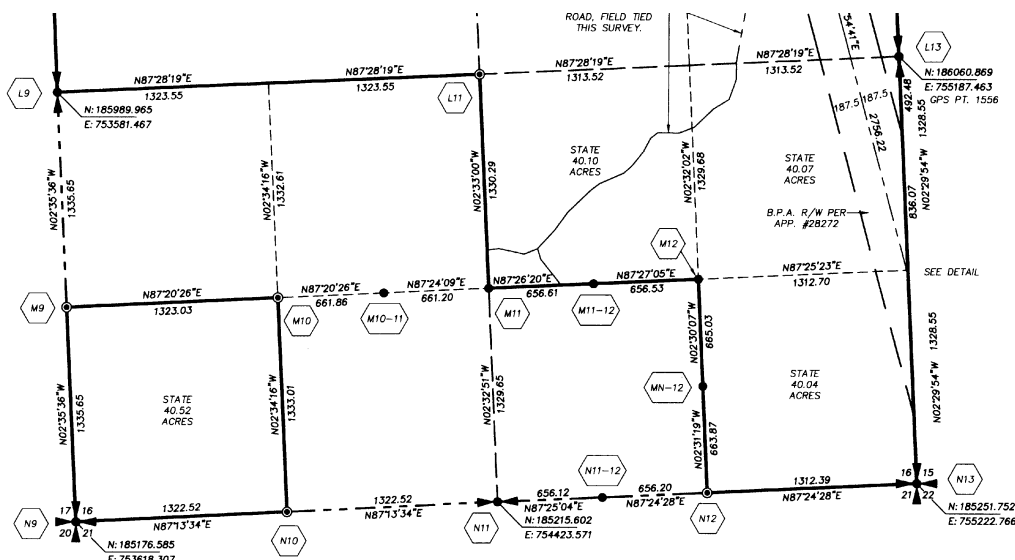
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BLM example of using local corners.
The Center 1/4 corner was set by a private surveyor using the wrong North 1/4 corner for control, but was still accepted as an angle point of the east-west section centerline.



Example of using local corners to subdivide a section.

The Center 1/4 corner is controlled by the accepted CS 1/16.
The SW 1/16 corner is controlled by the accepted C-E-SW 1/64. The E 1/16 corner on the south section line is controlled by the accepted W-E 1/64 corner.



Two Questions

Fred, a land surveyor licensed by the State, set a center 1/4 corner using the rules of Federal law. Fred recorded his survey in 1974. Fred was the first known surveyor to set a monument at the center 1/4 corner. You retrace Fred's work and find that you calculate the center 1/4 corner 1.2 feet north and 0.5 feet east of Fred's monument.

Where is the legal center 1/4 corner?

What points do you use to calculate the CW 1/16 ?

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